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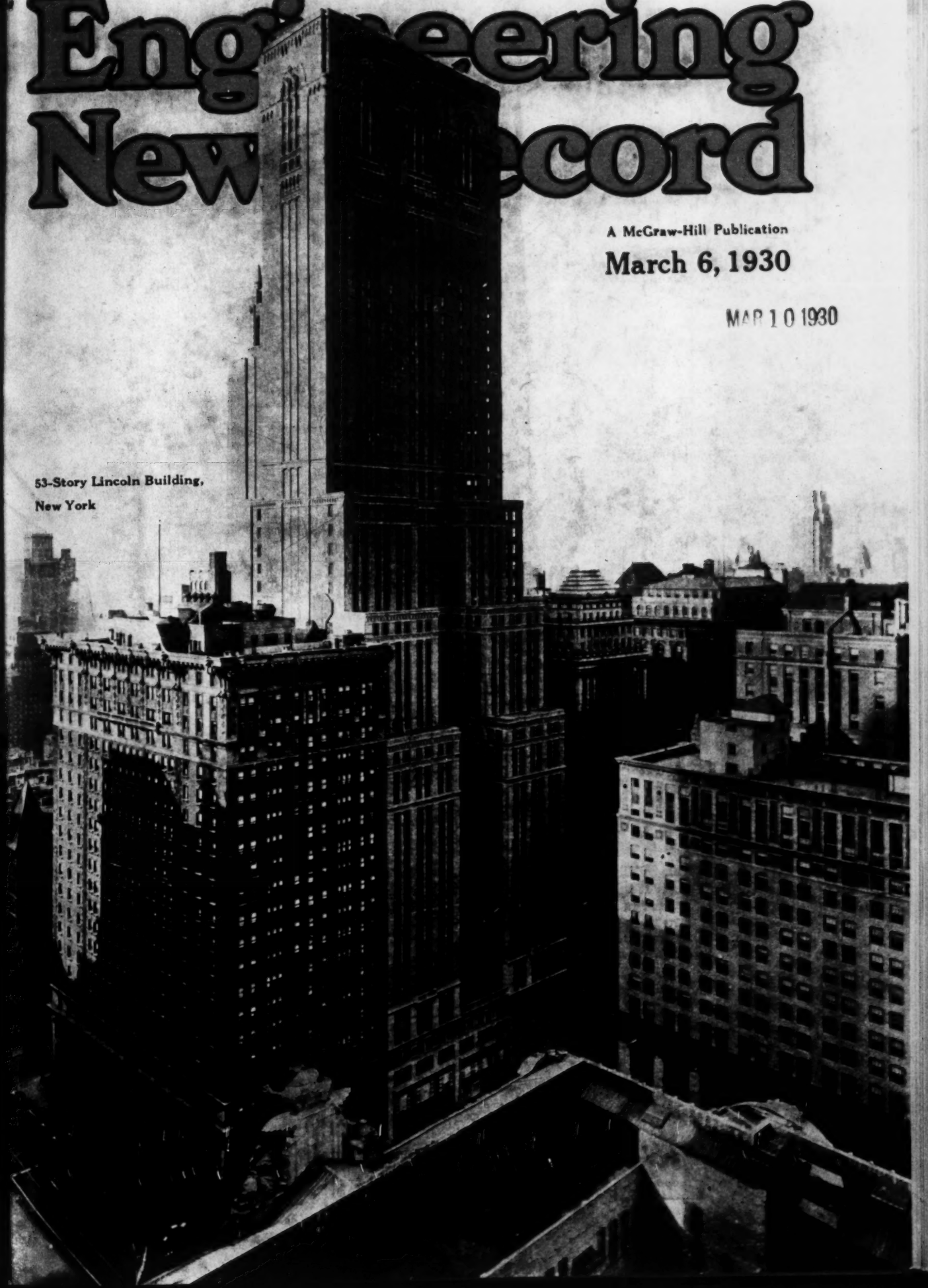

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A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

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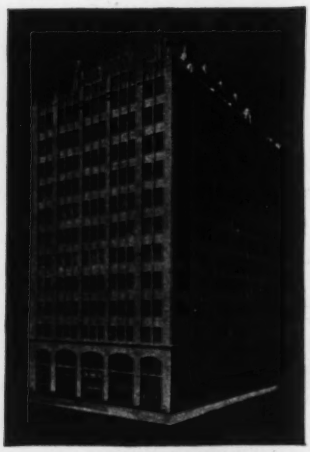

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ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION — ESTABLISHED 1874

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 104 NEW YORK, MARCH 6, 1930 Number 10

Lane-Marking Worth While

EVERY road user knows that traffic capacity and convenience, as well as safety, are promoted by lane-marking. Such systematic work as is being done by some states, notably California, brings significant improvement in road conditions. It is an element in developing the road as a tool of transportation, the present-day need. In earlier days, when highway authorities perforce centered all their activities on producing mileage of new road, the interests of operation and maintenance were so far secondary that they had to wait their time. Today the road problem has a rather different aspect, as is evident from the extensive attention which maintenance and operating matters now receive. Yet lane-marking has been slow to make headway in proportion to its importance. Many wide roads, boulevards and bridges are left without division of the traffic width, with continuing loss that is readily apparent to all who use them. Systematic extension of lane-marking promises to yield a material increase in efficiency of the highway.

Work and Efficiency

SENSIBLE men will not take much stock in the proposal of Senator Brookhart to appropriate $50,000,000 for unemployment relief. The slowdown of construction and general business since the end of November, now turning to a normal reanimation of activity with the approach of spring, is not something to be combated or reversed by forcible-feeding methods. In fact none of the attempts at artificial stimulation has had signal success, even the work of the promotion committee which was set up after the Hoover business survey conferences. When the business man or industrialist is asked to build or spend money for the public good rather than for his own needs, the argument is not persuasive. Disarrangement of credit necessarily breeds caution, and readjustment takes time, the more so when the banking world, which is the direct agency of credit allocation, takes an attitude of watchful waiting. Fundamentally the re-establishment of normal activity based on confidence and credit depends on the sound conduct of the individual business man—on his hard work and efficiency, which themselves are the outgrowth of good common sense. It is these qualities which will build up the coming season to match the best of recent years.

Sewage Treatment Change

PROGRESS in sewage treatment is shown by changes in Great Britain during the past 25 years. In many respects, progress has been along the same general lines here and in England. Today's most noteworthy features of sewage treatment are the growing use of the activated-sludge process and at the same time a reluctance to give up the older but relatively new combination of sedimentation, sludge digestion and trickling filtration. We still have far to go, and this applies to both countries, in finding the best means of sludge disposal, regardless of the general process of treatment used, and in determining the most efficient means of activation for the activated-sludge process. Activation methods are more diverse in England than America, but with no clear indication of which method is preferable—air diffusion or mechanical agitation. What the next quarter-century will bring forth in new methods of treatment or improvements in old practice is a question that only the bolder of those who have or assume to have the mantle of prophecy will attempt to declare. The one thing that seems surest is that no "do-it-all" in one simple process will be forthcoming but that with such a complex conglomeration as sewage, and with so many objects to be attained in its treatment, some division of labor, and probably a rather extensive division, will continue to be utilized.

Mergers Affect Engineers

HOW intimately economic and business changes touch the engineer may be seen in some phases of the current merger movement in power utilities. When power companies consolidate into larger systems or are absorbed by holding companies, engineering is usually centralized in the headquarters staff of the system, and the local engineering staffs are thrown out of employment. Consulting engineers also, who served the smaller company, find that their services are no longer demanded. The process is natural, in part inevitable, for combination finds part of its justification in the operating and administrative economies which it is able to achieve. In so far as centralized engineering service to a large group of companies is equal in efficiency to distributed local service, it therefore represents a gain. But in some cases, at least, the elimination of all local engineering skill represents a real loss in ability to appraise local problems and solve them with promptness and efficiency. This phase of the matter, we believe, is worth study by those who administer central organization of the kind in question. A related point that merits consideration is the loss in ingenuity and engineering resourcefulness entrained by the reduced diversity of engineering service. These points aside, the trend toward reduced scope of engineering opportunity in the power field is a real and serious phenomenon of present developments. It threatens to transform a field which in recent years has attracted many of the recruits to the engineering field, and render it distinctly less inviting as a career. In doing so, further, it deprives the power field of a distinct element of that vitality which grows out of technical strength and an independent professional class. Because this change must in time prove a loss to the power industry itself, the industry may wisely question whether

its present course of engineering centralization has been applied too extremely. In the meantime manufacturing industry should gain in the change, through the service it can derive from the power engineers who are displaced.

Buildings Without Attics

"WEDDING CAKE" buildings is what someone has called our modern tower structures that are being topped with spires, turrets and finials of every description. It is an apt description, and must seem particularly apropos to the engineers who design them. Like the chef, they have found that the cake itself is no task at all when compared with the icing. The fabricator and the erector, too, have learned to appreciate the analogy. But the situation is not so bad as it sometimes seems. There are still building owners who find that capitalizing the advertising value of useless topsail area is questionable business, however fascinating and self-satisfying it may be. Thus, in New York City, the huge Lincoln Building which has just been opened is characterized by strangely simple framing, a freedom from pointed towers and the entire absence of unusable attic stories. Similar examples in other cities are the Fidelity-Philadelphia Trust Building in Philadelphia, the Grant Building in Pittsburgh and the Daily News, the Palmolive and the new Civic Opera buildings, in Chicago. All have flat roofs and none is devoid of pleasing appearance, the last named, in fact, being one of the outstanding examples of modern building architecture. Apparently, buildings without attics still hold sway, even though spectacular exceptions sometimes becloud the fact.

A Veteran Passes

CLEMENS HERSCHEL achieved so much in the field of hydraulic engineering and continued to be virile and active by voice and pen for so many years after his nominal retirement that he will be missed as are few engineers when they die. Highly capable in his technical work, devoted to the best ideals of his profession and of citizenship, and gifted with keen wit tempered by humor and kindliness, he made a strong impress upon professional life, all the stronger because he was so long with us and championed his convictions with clear head, strong voice and able pen to the last. His professional career has added interest because he attained prominence in railway and bridge work before assuming high rank as a hydraulic engineer. His greatest and most lasting contribution to engineering and industry—a contribution that promises to be everlasting—was a simple device applicable to the measurement of liquids in unlimited quantities. To crown his long period of large-scale experimental work by which the device was placed on a sound practical basis, he named it for the long-dead Italian who established its underlying principle but probably had not dreamed of its most useful application. The Venturi meter, besides perpetuating a scientific name that would otherwise have been forgotten, will always stand alike as a monument to Herschel the engineer and Herschel the man.

For Safer Construction

SAFETY in the construction industry, off to a slow start and as yet far from the desired point of low accident records, is settling down to a practical basis, one indication that progress is being made. Sponsors of safety work are coming to realize the necessity of intelligent and common-sense direction that will reach the worker at his task. However, considering the safety movement in construction as a whole, the various leading groups still fail to agree on the policy of carrying on the work, whether it shall be by code or by education. The Engineering Standards Association in sponsoring a safety code has the co-operation of the National Safety Council but not that of the Associated General Contractors, the latter continuing to hold to the policy of safety promotion by education alone. The construction section of the National Safety Council is devoting most of this year's work to an endeavor to carry the safety idea to the various building trades employers' associations, thereby eventually reaching the individual contractor. The American Institute of Architects is working on a plan to incorporate safety measures into standard specifications. Meanwhile organized labor is demanding legislative protection and codes, and it is in a position to force safety laws and codes through most municipal and state legislative bodies. With all factors of the industry working toward a common end in safety, closer co-operation among all the groups is possible and desirable.

The Designer Responsible

EVERY structural failure is a reflection on the civil engineering profession and on the ability of each individual member of it. This fact is emphasized by the report in our news pages last week of the failure of the structural supports of a coal pocket in New York City, resulting in the death of three men and the injury of eleven others. To be sure, the structure was not an important one, but its unnecessary failure has a broad and direct bearing on the cause of public safety generally.

It required very little reading between the lines to realize that accepted principles had been violated wholesale, both in the physical make-up of the steel frame and in the circumstances that brought the structure into being. No capable engineer would have designed a column and girder framework to support a tall bin for pea coal without using bracing of some kind. No person with any regard for public safety would have used 4-in. beams as shims under a 14-in. I-beam. And the whole enterprise was unlawful, for aside from its bad design the structure was built without the required permit.

The district attorney of Bronx County, who is conducting an investigation of the collapse, is charged with grave responsibility in fixing the blame. It lies within his power to make such an example of this case that public safety the nation over will be benefited. Capable engineers have long tried to convince owners that a design which comes gratis with an order of material is more than likely no design at all. The collapse of this coal pocket is a vivid example of the catastrophe that they have known would happen if incompetent designs were not effectively curbed.

A strong, searching investigation by the district attorney can have important bearing on improving the public safety in two other directions. It can throw light on the question of why the city's dock department, which refused to issue a building permit for the job, could not or did not order work stopped on it. And it can point out that were there a provision in the building code making designers responsible for their structures such unnecessary

accidents as this coal pocket failure would in large measure disappear.

The latter is by far the most important lesson that can be learned from the collapse. A clause referring to design responsibility has been drafted for the New York City building code and will soon be up for adoption. When it is in force, no incompetent designer will dare take a chance with "junk-shop" structures. This coal pocket disaster should cause engineers and public-spirited citizens to redouble their efforts to get this important provision firmly entrenched in the new building code. Making the designer responsible is the key to greater public safety, to more efficient structures and to higher professional standing and attainment.

San Francisco's Ambition Fulfilled

WITH the transfer of the property of the Spring Valley Water Co. to the city of San Francisco on March 3, the largest of the private water companies passes out and the city fulfills its long-standing ambition for municipal ownership. Seventy years ago the company outdistanced a rival in building water-works and five years later it absorbed the rival.

Just when the demand for municipal ownership arose cannot be stated, but in 1871 Thomas H. Selby, then mayor of San Francisco, declared: "The whole subject of an increased supply ought to be submitted to the board of public works with the view of making it a public enterprise to be owned by the city." Before the end of that decade one or more lengthy engineering reports on possible municipal works had been submitted to the city government. By far-seeing enterprise the company early acquired all sources of supply on the peninsula and some on the mainland, but to go farther afield became more and more problematical in view of the increasing demands both for more water and for municipal ownership.

These conditions led to the city's planning the Hetch Hetchy project for bringing in by gravity an impounded supply from the Tuolomne River, against the strong opposition of "nature lovers," irrigation districts, hydroelectric interests and the Spring Valley Water Co. This huge project was predicated upon acquisition of the distribution system of the water company, which, with the company's sources of supply, reservoirs, aqueducts and pumping stations, has just been taken over. Repeated defeats of bond issues to pay for the company's property have not meant lost interest in municipal ownership, for always there has been an actual but not until about a year ago the required legal majority in favor of the purchase. Lack of the high majority required was at least partly caused, in the earlier elections, by the long period needed to complete the city's great acqueduct, and in the later elections by a lack of haste for the same reason and by uncertainty as to how the city would administer the works when in its possession.

The Spring Valley Water Co. should not pass into history without testimony to its notable achievements. Under the lead of Herman Schussler and other able engineers the company has pioneered in the use of riveted sheet metal pipe lines and has built dams notable in their day. Few if any large water-works, regardless of ownership, were metered so early and so completely as these. The hygienic quality of the supply, thanks to the choice of sources and safeguards effected, has been high—health reports indicating, it is said, no death from communicable disease attributed to the company's supply. Fortunately, the city is to take over most if not all the operating staff of the company, but the general administration will be tied into the city government.

Hidden Values

THE first stage of what will be one of the largest waterpower developments in the world is now under construction on the Saguenay River in Quebec. When completed, the development will have more than one and a quarter million horsepower installed in two plants. But great size is not the most remarkable feature of the development. It is rather that the power plant now under construction, a plant with an installed capacity of 260,000 hp., will be used only for stand-by purposes or for the generation of secondary power when the larger plant is completed in the second and final stage of the development.

During the few years that will elapse between the time the first plant is brought into service and the second plant is completed it will be called upon to generate primary power at a high load factor, the most valuable kind of power; subsequently it will be relegated to the generation of low-grade power. This fact not only demonstrates strikingly the rapidity with which our demand for electric power is developing but also shows the way in which industrial rather than physical conditions often may dictate how a power site shall be developed. The latter is significant in this day of trying to determine the value of utility properties from existing physical evidence, especially for those who would write off that part of the capital which appears from such evidence to have been imprudently invested.

The total head which may be developed in the section of the Saguenay River under consideration is 205 ft. It can all be developed in one plant having a capacity of about 1,000,000 hp., and will be so developed in the final stage of the project now under construction. But this can be accomplished only by the expenditure of large sums of money and much time in the construction of a major river diversion channel. Meanwhile the company developing the power site needs more power. It cannot well afford to wait for the completion of the entire project, because to do so would be to hold up industrial development which cannot be undertaken until large quantities of relatively cheap power are available. As an alternative it has undertaken the development of part of the total head in a power plant located on the river in the main diversion dam for the larger project. The first units of this plant will be ready for service in 1931. Construction of this initial stage plant also will cut down interest charges during construction on a considerable portion of the investment required for the larger project. In the light of present-day knowledge of the industrial requirements of the region its construction is fully justified.

But what of the future? Will valuation experts of the future be likely to decide that this present plant which then will be developing only secondary power had ample justification for its construction on the present site, or will they decide that the money invested in its construction was spent foolishly; that more units should have been installed in the higher-head plant for the development of secondary power? These are considerations of a kind not to be overlooked when the reasonableness of past expenditures made in the development of utility property is in question.

Steel Framing Simplicity in 53-Story Lincoln Building

All Setbacks Are Made on Column Lines and the Tower Is of Economically Rentable Size—Special Construction Includes Eccentrically Loaded Trusses Over Entrance Hall and Slab Wing Plates on Column Bases

By Albion N. Van Vleck
Hurlbut & Van Vleck, Consulting Engineers, New York City

STEEL framework to achieve economy by simplicity characterizes the Lincoln Building, a new 53-story structure across 42d St. from Grand Central Terminal, New York City. The designers were fortunate in that the proportions of the structure, and particularly the plan of the base, were such that a tower 160x66 ft. could rise from the 33d floor to the top of the building without setback. The architect co-operated to the fullest extent in altering his plans to conform to the results shown by the studies of economic framing.

All setbacks were made to fall on column lines. Columns were lined up in bents in both directions. Offset girders were eliminated, except for a few small ones in the penthouse portion of the building, used to secure an architectural relief effect in topping out the tower. The spacing of beams and girders was determined in the interest of structural economy. As a result of these efforts at framing simplicity, comparison of the total structural steel (16,941 tons) with the volume of the building (approximately 15,000,000 cu.ft.) shows a low value—less than 2.26 lb. of steel per cubic foot.

The Lincoln Building is H-shaped in plan above the sixth floor, the tower occupying the center of the H as well as extending to the east building line. Referring to Figs. 3 and 4, the tower is outlined by columns 4, 9, 189 and 184. In addition, an arm 27 stories high extends westward from the main building, providing an

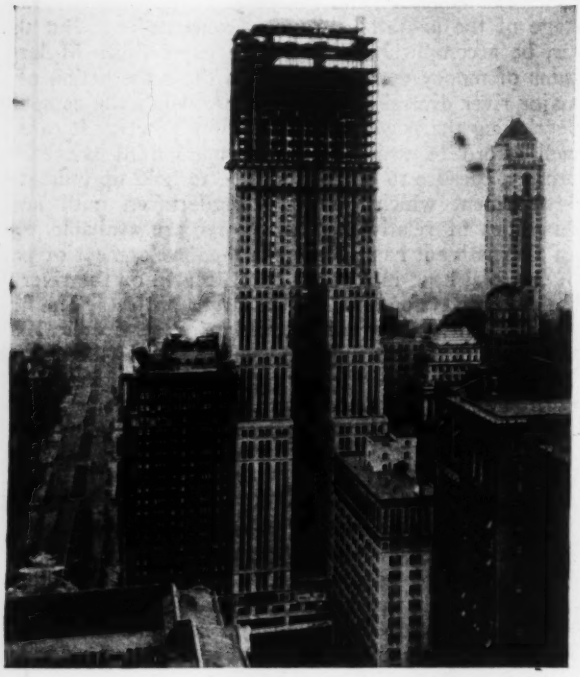


FIG. 1—THE 53-STORY LINCOLN BUILDING, NEW YORK CITY
Roof of Grand Central Terminal in left foreground, Hotel Belmont immediately beyond. At right, tower of new Arnold-Constable Building.

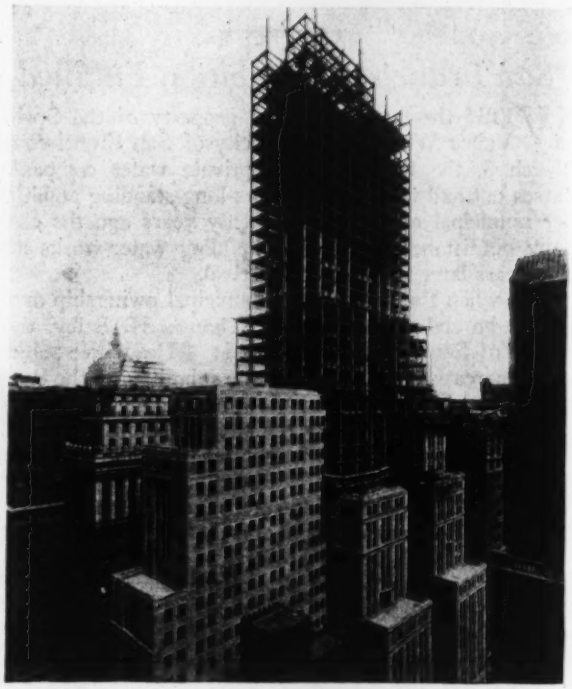


FIG. 2—STEELWORK OF LINCOLN BUILDING, FROM 41ST STREET SIDE
Arm at left extends out to Madison Ave.

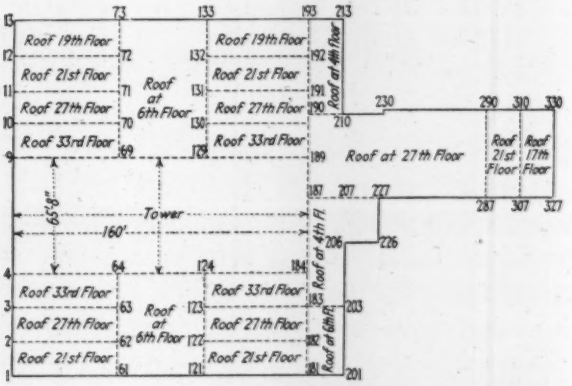


FIG. 3—SETBACK DIAGRAM, LINCOLN BUILDING, NEW YORK CITY
Tower, outlined by columns 4, 9, 189 and 184, extends from the 33rd floor to the top without offset.

entrance on Madison Ave. The other entrances are on 42d and 41st Sts., respectively. Fig. 4 shows a plan of the second-floor framing, and Fig. 3 indicates the floors at which setbacks occur, showing how each of these setbacks is one panel in depth, eliminating the necessity for offset girders.

One complication in the framing occurred over the entrance arcade on the first floor, where six one-story A-trusses were necessary in order to provide a hallway 22 ft. wide between columns, the prevailing column spacing being only 18½ ft. A detail of one of these trusses, shown in Fig. 7, indicates the large eccentricity of the load it carries. The magnitude of this load, approximately 4,000,000 lb., created a considerable problem of design at the connection of the column to the apex of the truss. A gusset plate large enough to transfer the stress would have occupied valuable space on the third floor and would have encroached on a necessary door opening through the truss on the second floor. The problem was solved by transferring the column load into the truss by direct bearing, machined surfaces being provided on the main truss member and on the 3-in. billet on the column base.

Another complication occurred in the east wall of the building, which adjoins the west wall of the old Hotel Belmont. Because of the danger of damaging the cellar walls of the hotel, the pier holes along the building line, all of which penetrated a considerable depth below the bottom of the hotel basement, were line drilled and chipped out of solid rock, a slow and expensive procedure. Also these pier holes were set back some 2½ ft. from the building line. The east wall columns outside of the tower were carried on cantilever girders (Fig. 7). The east wall columns in the tower were centered over the piers, which required that the wall be carried on outriggers about 3½ ft. long at each floor.

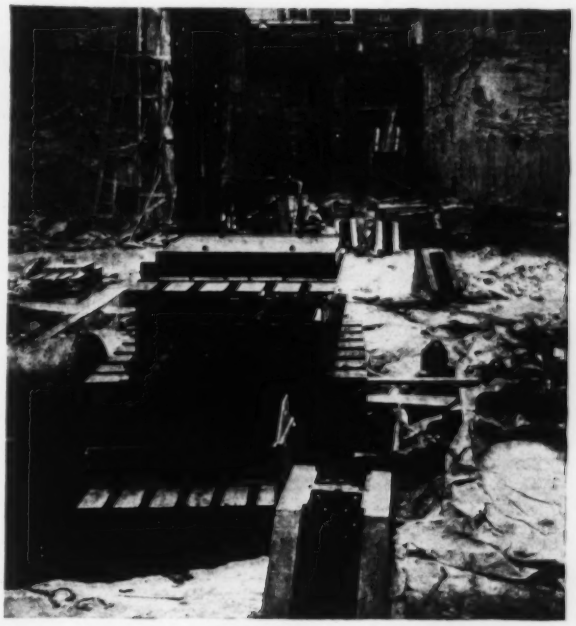


FIG. 5—FOUNDATION SITE, LINCOLN BUILDING, BEFORE GRILLAGES WERE SET
Note column bases with wing plate billets.

On all faces of the building wall plates were used on the spandrel beams to provide for deep reveals called for on the architectural plans. Practically the only other steelwork made necessary by architectural adornment occurs above the 53d floor. Here, false pointed arches of brick and terra cotta are carried on curved angles springing from the 53d floor (Fig. 4).

As is usual in most buildings, the elevator shafts imposed limitations on the most economical use of steel in the portion of the building where they occurred. In the

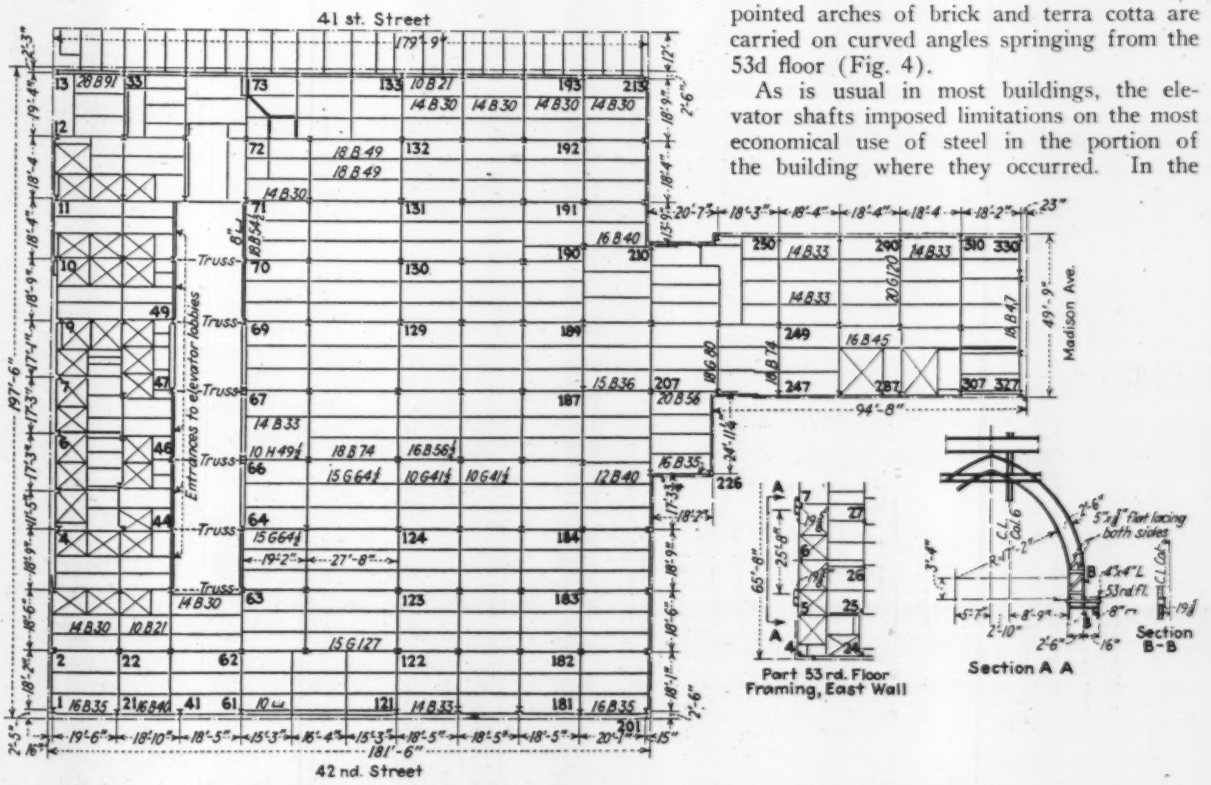


FIG. 4—SECOND FLOOR FRAMING PLAN AND FRAMING DETAIL AT 53D FLOOR
Steelwork shown for 53d floor represents major part of steel required to support architectural adornment.

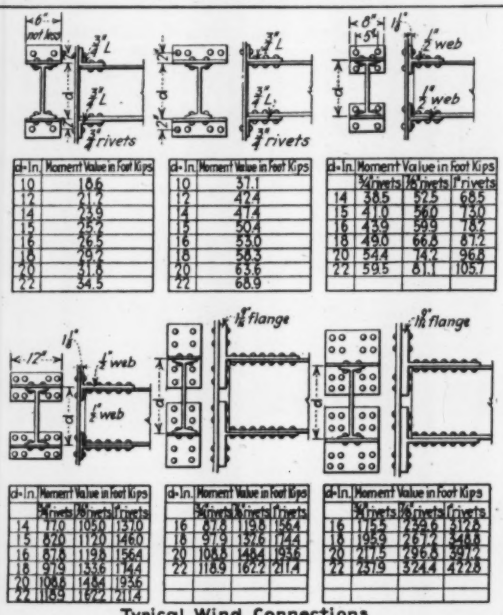
Lincoln Building the elevator banks are concentrated along the east wall, east of the main entrance arcade. Elevator lobbies, reached by five entrances from the main arcade, provide access to 29 high-speed self-leveling elevators servicing all 53 floors of the building.

Columns and Bases—Rolled sections were used as the bases for the make-up of the columns. Since some of the column loads exceed 4,500,000 lb., heavy reinforcing was necessary on the tower columns in the lower portion of the building. As shown in Fig. 7, this reinforcing consisted of cover plates and either web plates or web angles. An unusual feature was that the flange cover plates for the heavily loaded columns consisted of solid billets, the largest being 24 in. wide and 3½ in. thick. All of these billets were shop-riveted cold, using 1¼- and 1⅛-in. rivets.

Columns 126 and 127, carrying loads of 4,525 and

FIG. 6—WIND DESIGN AND STANDARD WIND CONNECTIONS, LINCOLN BUILDING

Shears and moments in each wind bent were calculated as shown; only a representative number are given, but others can be calculated from the data given. The detailer chose the type of wind connection for a particular location from the typical list, in which each connection serves a certain range of bending moments.



d-In.	Moment Value in Foot Kips
10	16.6
12	21.9
14	23.9
15	25.2
16	26.5
18	29.2
20	31.8
22	34.5

d-In.	Moment Value in Foot Kips
10	37.1
12	42.4
14	47.4
15	50.4
16	53.0
18	58.3
20	63.6
22	68.9

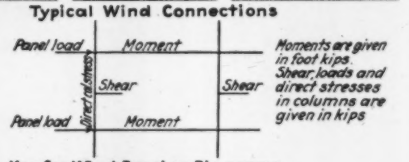
d-In.	Moment Value in Foot Kips		
	¾" rivets	⅞" rivets	1" rivets
14	38.5	52.5	68.5
15	41.0	56.0	73.0
16	43.9	59.9	78.2
18	49.0	66.8	87.2
20	54.4	74.2	96.8
22	59.5	81.1	105.7

d-In.	Moment Value in Foot Kips		
	⅞" rivets	1" rivets	1⅛" rivets
14	770	1050	1370
15	826	1120	1460
16	878	1196	1564
18	979	1336	1744
20	1086	1484	1936
22	1189	1622	2114

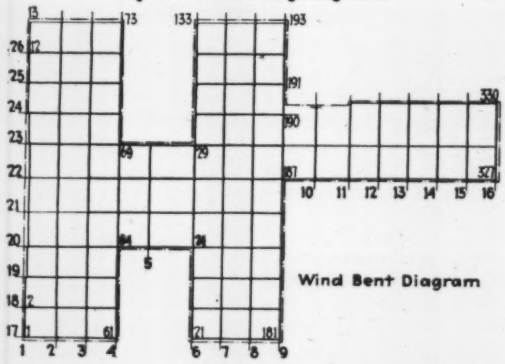
d-In.	Moment Value in Foot Kips		
	⅞" rivets	1" rivets	1⅛" rivets
16	976	1330	1564
18	979	1376	1744
20	1086	1484	1936
22	1189	1622	2114

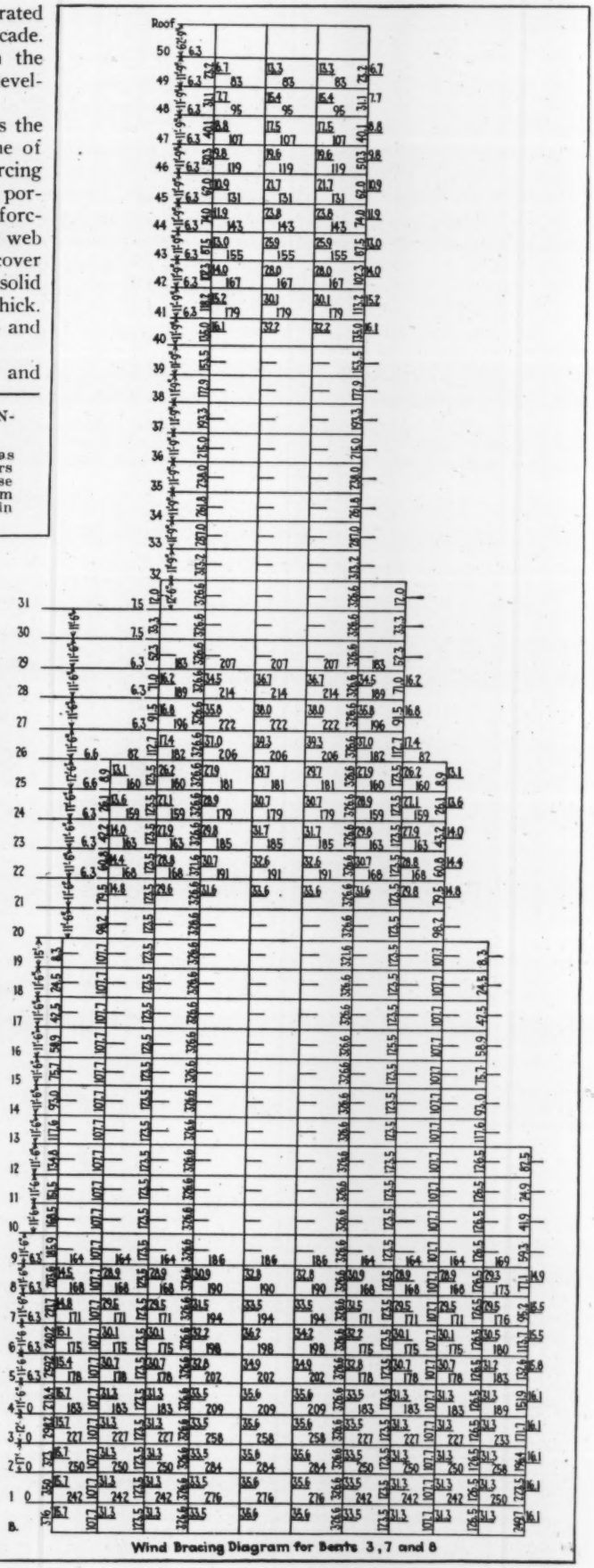
d-In.	Moment Value in Foot Kips		
	⅞" rivets	1" rivets	1⅛" rivets
16	1753	2396	3128
18	1959	2672	3488
20	2175	2968	3872
22	2379	3244	4228

Typical Wind Connections



Key for Wind Bracing Diagrams





Wind Bracing Diagram for Bents 3, 7 and 8

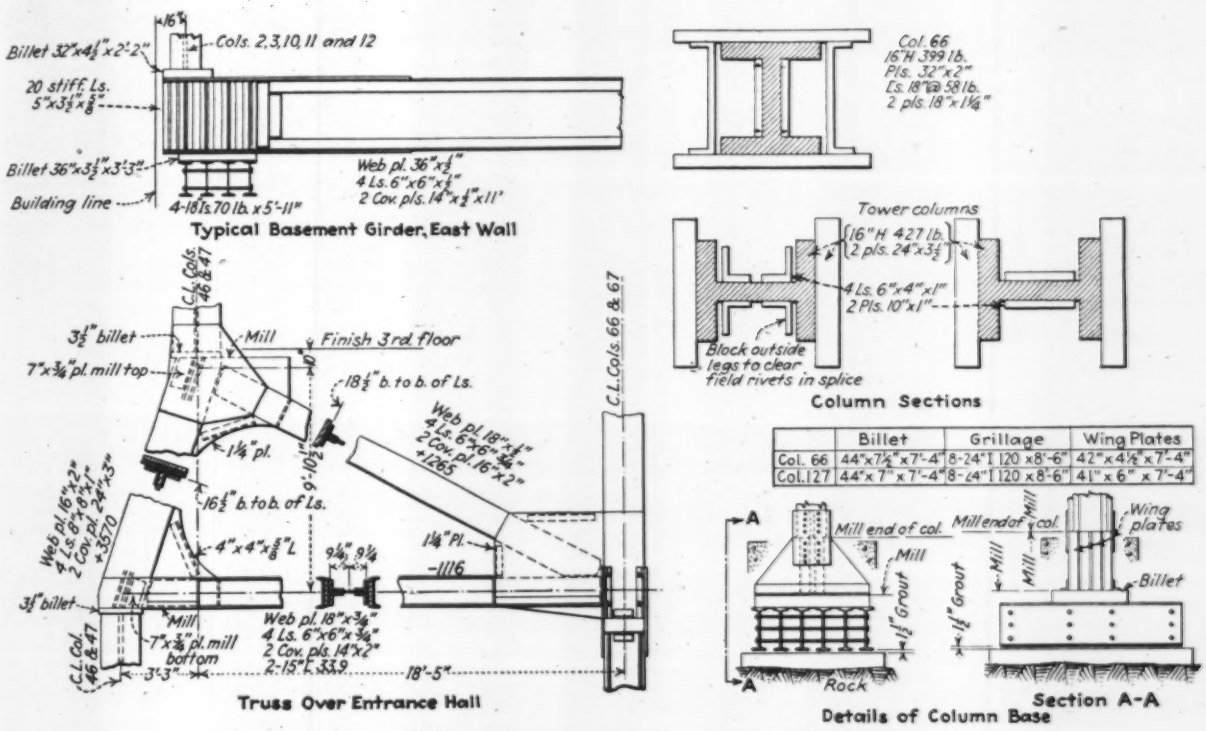


FIG. 7—SPECIAL STRUCTURAL DETAILS, LINCOLN BUILDING, NEW YORK CITY

Note large eccentricity of load in trusses; also method of transferring column load into truss by direct bearing, thus eliminating large gusset plates. Note also similar arrangement in column base in which load is transferred to base billet by wing plate billets set on edge.

4,613 kips respectively, consist of a 16-in. 427-lb. H-section, two billet flange plates 24x3½ in. and four web angles 6x4x1 in. Column 66, a special column, carrying a load of 4,681 kips, consists of a 16-in. 399-lb. H-section, two flange cover plates 32x2 in., two web plates 18x1¼-in. and two 18-in. 58-lb. channels.

Unique column bases were used to distribute the heavy loads over the I-beam grillages. In these bases the wing plates were made up of billets; in column 127 the billets are 6 in. thick and bear on a base billet 7 in. thick, as shown in Fig. 7. The edges of the wing-plate billets were machined so that the loads could be transmitted by direct bearing instead of through rivets.

Windbracing—The wind stresses were determined by the Fleming portal method in accordance with New York City building code requirements. A set of standard wind connections based on wind moments was worked out, as shown in Fig. 6. The wind stress diagrams, also shown in Fig. 6, gave the shears and moments in the columns and girders so that all the detailer had to do was to select his connections in accordance with the moments listed. The majority of the wind connections were of the usual split-girder type.

The simplicity of the steelwork also contributed to ease of erection. By using five derricks and a loading platform across the court on the 41st St. side, the entire steel was erected in 89 working days. The design itself took about 2½ months to complete, with an average of ten men working approximately 60 hours each week.

The building was designed by the writer's firm, Hurlbut & Van Vleck. The McClintic-Marshall Co., Pittsburgh, fabricated and erected the steel for Dwight P. Robinson & Co., the general contractors. J. E. R. Carpenter & Associates were architects for the owner.

Why the Low-Water Stage at Cairo Is Getting Higher

By Ramey Williams
Memphis, Tenn.

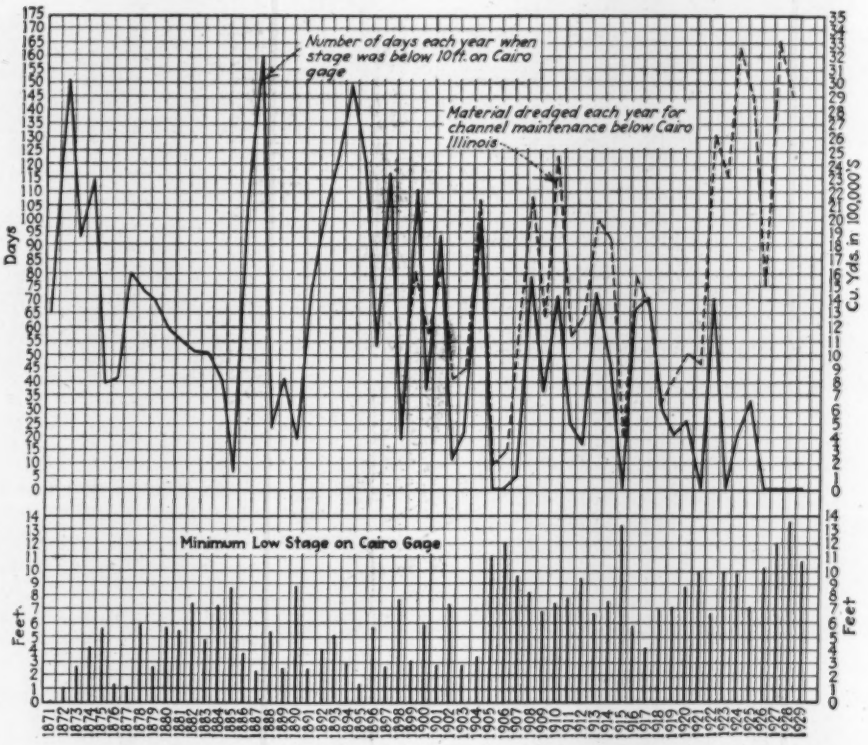
LOW-RIVER stages at Cairo, Ill., have been gradually increasing since 1871, when the gage was established by the Weather Bureau. A graph of the minimum stages reached each year and the number of days in each year when the stage was below 10 ft. is shown. Notwithstanding the many fluctuations of the minimum low, the general trend is upward. The number of days per year when the river was below a 10-ft. stage decreases irregularly as the years go by.

For the first ten years (1871-1880) of the 59-year period, the mean low was 2.83 ft. and the average number of days when the stage was at or below 10 ft. was 78.7. For the last ten years (1920-1929) the mean low was 9.8 ft. and the average number of days per annum when at or below 10 ft. was only 17.0.

Various theories might be evolved in explanation of this marked change in such a relatively short time, geologically speaking. It might be merely one phase of a periodical recurrence. However, the most plausible explanation seems to be that it is the resultant effect of several causes such as the following: (1) the 8,000 to 10,000 sec.-ft. of water diverted at Chicago from the Great Lakes, which is an appreciable percentage of the total discharge during low-water periods; (2) the completion of the lock-and-dam system on the Ohio River, which, by retarding the flow at some half a hundred places, tends to equalize that river's discharge at Cairo by distributing the volume more evenly during

the periods of time intervening between showers; (3) the construction of contraction works on the Mississippi River above Cairo may have caused much material to be moved into the river below Cairo and thus fill its bed.

The last-named cause does not seem to be improbable when considered in conjunction with the information contained in a hydrograph of the St. Louis gage, prepared by William M. Penniman, engineer, by direction of John C. Gotwals, major, Corps of Engineers, U. S. A., which shows a drop of 6 ft. in the low-water plane at St. Louis, Mo., between 1881 and 1928. That is, at the standard low water of 4 ft. above zero of the St. Louis gage, adopted in 1881, the discharge was then 40,000 sec.-ft., but a like amount passed in 1928 at a stage of 2 ft. below zero of the same gage.


Number of days each year when stage was below 10ft. on Cairo gage
Material dredged each year for channel maintenance below Cairo Illinois
Days
Cu. Yds. in 100,000's
Minimum Low Stage on Cairo Gage
Feet
Feet

GRAPHS OF LOW-WATER GAGE READINGS AT CAIRO, ILL., AND OF YEARLY DREDGING VOLUMES SOUTH OF CAIRO

Whatever the cause, the inference would seem reasonable that the increased low-water stage at Cairo would create an increased natural depth of the low-water channel, but a study of the upper graphs will show that apparently such is not the case.

Although the depth of water across an obstructing bar on the lower Mississippi River is not always a function of the river's stage, it is only during periods of low water that these bars are an impediment to navigation; therefore at the time the project for channel maintenance, by dredging, was adopted by the Mississippi River Commission it was seldom necessary to begin dredging operations until a stage of 10 ft. on the Cairo gage was reached or appeared to be immediately probable. Also, whereas experimental dredging was begun in 1893, a sufficient number of dredges and attendant plant for the maintenance of the 9-ft. project was not provided until 1898.

As shown by the graphs, for the first few years after the beginning of dredging operations the amount of material removed each year for channel maintenance varied directly as the number of days when there was a stage of 10 ft. or less on the Cairo gage. Later, for several years, the amount of material removed was generally in sequence with the number of days when below 10 ft., but it gradually increased until 1922. After that year there does not appear to be any relationship between the amounts and the days. To a limited extent these variations were possibly due to the following causes: (1) some additional material removed during the interval 1907-1909 at certain selected localities in connection with the 14-ft. project; (2) reconnaissances, surveys as well as dredging being much restricted on account of labor shortages during 1917 and 1918; (3) some experimental dredging done in 1927 and 1928, which is included in totals. None of these operations, however, was sufficient to affect materially the great differences between the amounts removed at the beginning and at the end of the 31-year period, 1898-1928.

For the first ten years (1898-1907) the average annual amount dredged was 1,046,000 cu.yd., and for the last ten years (1920-29) the amount annually removed to maintain the same project averaged 2,500,000 cu.yd. It may be stated that during both the above-named periods there were isolated instances where the channels of required width and depth were not provided, but from the records and personal observations it is not believed that these failures were more frequent or of longer duration during the first than during the last period.

No attempt will be made to explain the phenomena discussed, for the more I study the Mississippi River the less I understand it.

Tests Being Made of Railroad Brake Equipment

A series of more than 500 field tests on railroad braking equipment is being conducted by the American Railway Association on the lines of the Southern Pacific Ry. near the Oregon-California boundary. These tests, which began last August, will require a year for completion and constitute the final stage of research work begun in 1925 by the A.R.A. in this general field. Previous tests have been conducted on a test rack at Purdue University, and the road tests now in progress are to check the findings of the rack tests and to obtain additional data. The section of railroad selected was chosen primarily because of the variety of topographic conditions encountered within a limited mileage, and plans call for tests under various conditions of loading, speed and grade. The results of this work are expected to show whether or not changes could be made in freight-car brake design that would improve the safety and efficiency of railroad operation.

Sound Reflector of Novel Design for Hollywood Bowl Stage

Half of Truncated Cone Supported by Ten Steel Arches Forms Shell Which Can Be Moved From the Stage on Wheels

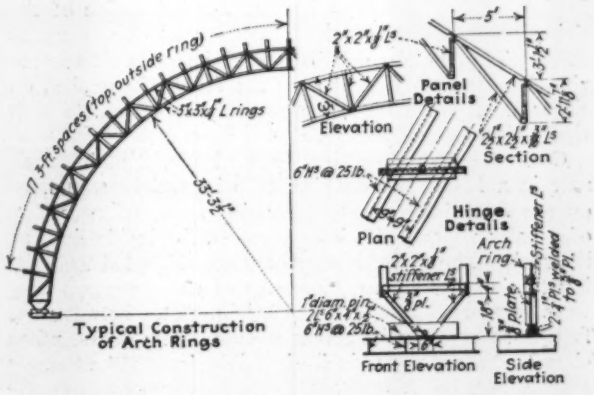
By O. G. Bowen
Elliott, Bowen & Walz, Engineers, Los Angeles

AN ORCHESTRA shell or sound reflector mounted on wheels was recently completed for the stage of the Hollywood Bowl, an open-air amphitheater in Los Angeles, Calif. The shell structure is entirely separate from the stage proper and consists of a platform, 45x105 ft. in plan with a superstructure in the form of half a truncated cone supported on a series of semi-circular steel arches. The floor system is of wood, supported on steel I-beams, and the steel frame superstructure was put together entirely by the welding process, no rivets being used in fabrication or erection. The inside and outside covering of the steel frame consists of asbestos sheets, about 3x6 ft. in size, fastened to the steel frame by means of specially designed galvanized steel clips.

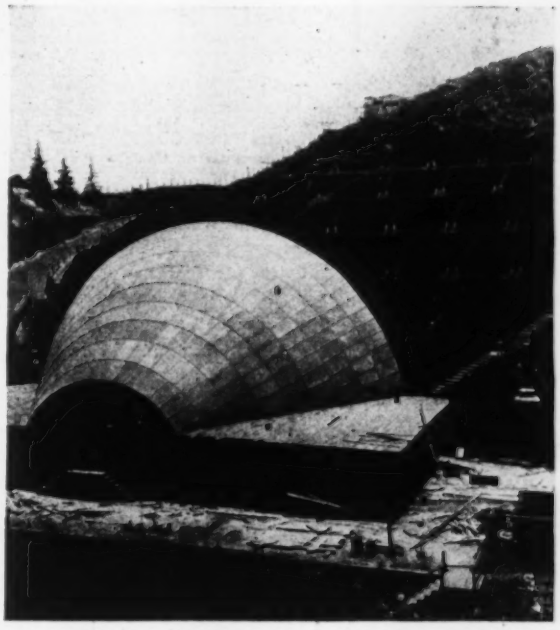
The function of the shell is to project the sound from the stage over the seating area in such a manner that audibility in all of the 25,000 seats will be satisfactory. The distance from the front of the stage to the rear seat of the bowl is 550 ft.; the bowl floor slopes upward from the front row on an angle of approximately 12 deg.

Various trials were made in this amphitheater with orchestra shells of different shapes. One of these had a vertical reflecting surface behind the orchestra and a sloping reflecting surface above. Later, a shell was constructed using the combination of vertical walls behind and at the sides of the orchestra, with plain parabolic surfaces above. This shell gave strong reinforcement of the sound but overemphasized the sounds from instruments located at the focal points of the three overhead parabolic surfaces.

The final design, according to which the structure was built, is described in the following. It consists of a number of concentric overhead reflecting surfaces, all except the extreme front and extreme rear having an inclination of 51 deg. to the horizontal. This angle would be 45 deg. if persons in the audience were seated on the same plane as the stage. Since the audience seating plane is inclined, the optimum angle is 45 deg. plus one-half the 12 deg. elevation of the seating plane.



ARRANGEMENT OF ARCH TRUSS MEMBERS

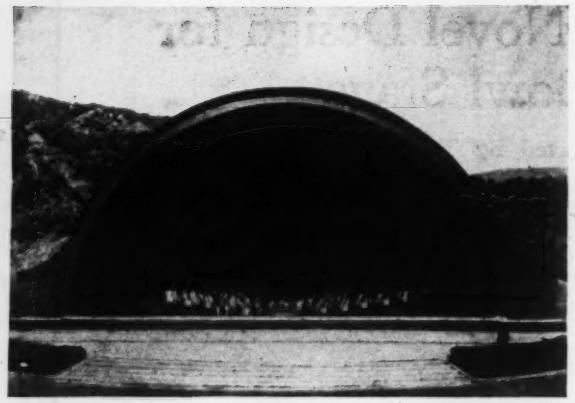


HOLLYWOOD BOWL FROM BEHIND THE NEW SHELL
The amphitheater has seats for 25,000. The orchestra shell can be rolled to one side, leaving the stage unobstructed.

The use of several concentric, circular bands that make up the shell overcomes the difficulty of the focusing effect. As built, the shell is free from such defects as echoes and sound foci, and sounds originating at any point on the orchestra platform are directed toward the listeners in the bowl, with a slight preference for those seated at the greatest distance from the stage. Those who are nearer receive an adequate amount of sound energy by the direct waves, and thus compensation for the more remote seats was made purposely.

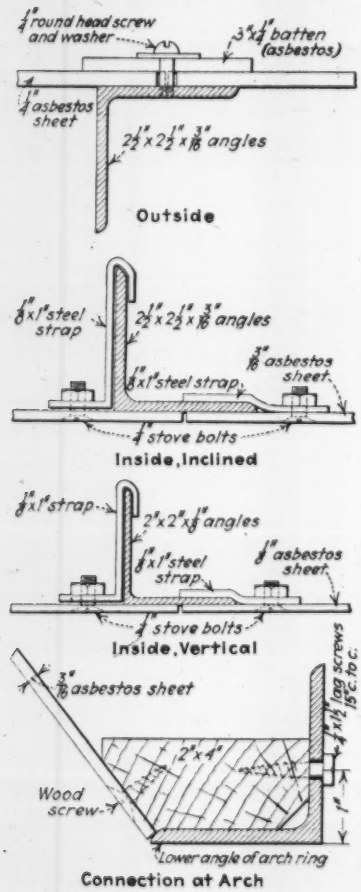
After completion of the shell a rough acoustical test was made. One No. 10 birdshot was dropped various distances onto a kettledrum located near the center of the shell. Listeners were placed at 26 locations in the bowl. The shot was first dropped a measured distance of 8 in. and was heard over the entire bowl area. The drop was then decreased and the varying degrees of audibility in various parts of the bowl were plotted. The results proved that one No. 10 birdshot (weight 0.00115 oz.) dropped $\frac{1}{4}$ in. onto the head of a kettledrum could be heard distinctly over three-quarters of the area of the bowl. Numbers were then whispered from the shell and were called back by persons stationed in all parts of the bowl's seating area.

The primary purpose of mounting the shell on wheels



FRONT VIEW OF SHELL AFTER COMPLETION
Inner radius of the semicircular arch at the front of the shell is 42½ ft.

was to permit of its easier removal to a position about 400 ft. up the canyon where it would be out of sight of the audience, thus allowing great pageants and similar productions to be held on the original stage with only the natural setting of the hills as background. (It is proposed to make the excavation necessary to move the shell the necessary distance on a level track.) A secondary consideration was to make a feature of the moving operation by having the audience seated first and then bringing on the shell completely lighted and with the orchestra playing. Movement of the shell is to be accomplished by a power-driven winch with an endless cable to an anchorage at the far end of the track. Remote control of the motor drive probably will be mounted in the shell.



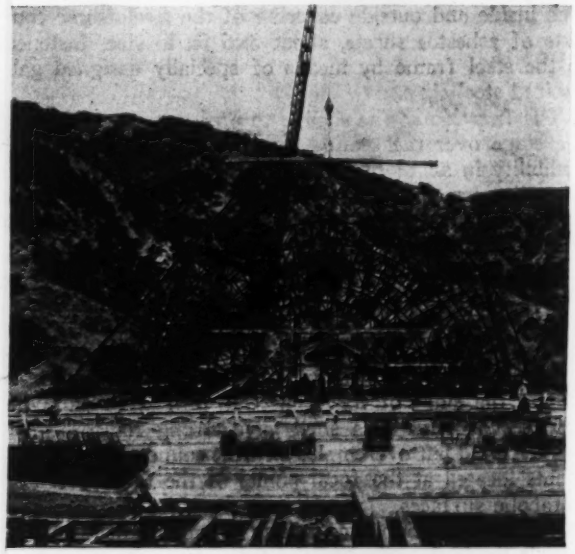
DETAILS OF ASBESTOS SHEET FASTENINGS

The over-all platform area of 45x105 ft. is occupied only partly by the superstructure or shell. The shell is one-half of a truncated right circular cone, having an outside radius at the front of 45½ ft. and 18 ft. at the small end. Portions of the platform outside and to the rear of the shell are roofed over with a ceiling height of 8 ft., this space being used for dressing rooms and storage.

The shell structure complete is supported on a floor system that rolls on five lines of rails supported on the original stage floor. To make the tops of the rails level despite the slope of the stage floor, 6-in. timbers of varying thickness were used. These timbers were fastened to the stage by clip angles and capscrews which fitted into inserts in the stage floor. Bracing beneath the floor had to be strengthened to carry wheel loads under the shell when it was moved. Sufficient additional support was provided by putting in 3x12-in. headers between the joists for 2½ to 3 ft. on either side of the rail.

The wheels are double-flanged cast iron, 6 in. in diameter, with thrust ring roller bearings lubricated by a pressure system through holes drilled in the shafts. There are 47 such wheels, the wheel mounting consisting of a pair of 6-in. channels along each line of wheels, these channels also serving as girders to support the floorbeams. The floor supports are 6-in. I-beams carrying 2x4-in. nailing strips, to which 1¼-in. tongue-and-groove flooring is nailed.

Each arch of the shell superstructure is supported on two 6-in. H-sections placed on top of the channel beams. Across the pair of H-beams two angle irons



STAGE WITH FRAME OF SHELL UNDER CONSTRUCTION
Ten semicircular steel arches were erected to form a sound reflector. Natural setting in background.

constitute the pin support for ends of the two-hinged arches. Each arch consists of 3x3x1¼-in. angle flanges and 2x2x⅛-in. angle web members, except in the lower portion of the four front arches, where the size of the web members was increased to carry the heavy radial sheer. This design had to be varied somewhat to provide for the 7x7-ft. door near the front of the shell on either side, which made it necessary to terminate arch No. 2 above the doorways.

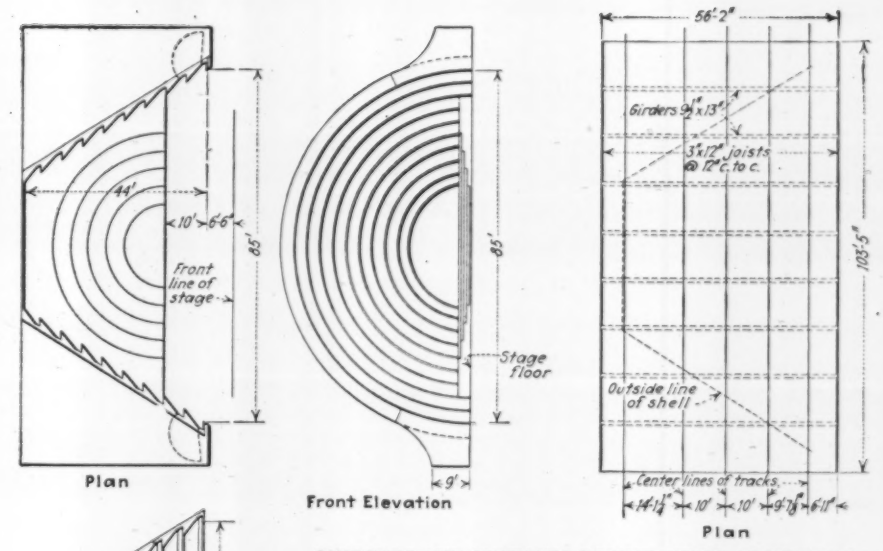
Over the doorways both ends of No. 2 arch terminate in a 12-in. H-section of 65.5 lb. weight supported on the door jamb members, which were, of necessity, of greatly unequal depth to preserve the inside lines of the shell. The 12-in. H-members are subjected to bending torsion and thrust. Because of these stresses they were reinforced by welding 10x½-in. plates between the flanges so as to make a box section. The doors, when closed, are made practically invisible from the front by maintaining the same lines as the inside surface of the shell.

Stress analysis of the arches was made by applying the theory of the deflection of curved beams and the aerodynamic theory of wind pressure on a cylinder. Two separate analyses were made —one for wind stress and one for dead loads. Equations were written and solved for thrust, moment and radial shear, and the corresponding curves were plotted. It was thus possible to compute the maximum flange section required and the size of the web members at the various points without the use of the usual stress diagrams.

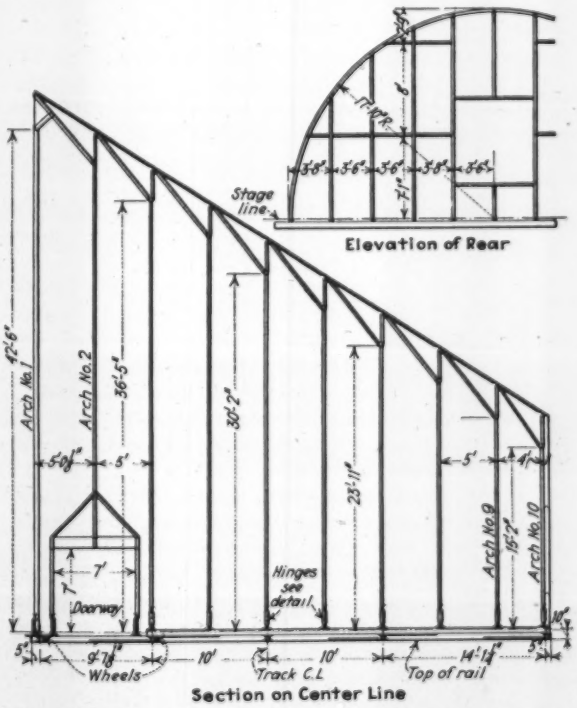
The method of erection consisted in building up segments of the arches in the shops where the fabrication was done, using three segments for the smaller arches and five for the larger. These segments were delivered to the job and there welded together on the ground. Each complete arch ring was then hoisted into place by the derrick with the aid of a timber arch bridle used as a stiffener.

The weight of the structural steel was 36 tons. The weight of the entire movable structure, exclusive of the walls and roof over the dressing rooms, was approximately 55 tons.

A feature of the design was the curtain put in to close the front of the shell against the weather while not in use and to afford an awning during rehearsals.



OUTLINES AND SECTIONS OF THE SHELL STRUCTURE..



SECTION THROUGH SHELL AND REAR ELEVATION

The curtain consists of No. 8 specially treated water-repellent duck made up in two quadrant-shaped pieces whose lower edges are fastened along the front of the stage. The two quadrants open and close like a fan, meeting on the vertical center line. To support and operate the curtain a track was built along the outer perimeter of the shell front to engage wheels attached to the curtain. Operation is by means of an endless cable leading to a hand winch in the left wing. When not in use, the curtain is stored in a box whose cover forms the front portion of the stage door.

The structural steel frame was fabricated and erected by the Consolidated Steel Corporation, and the general contractor was the Schofield-Twaits Co. The shell was designed and supervised by Elliott, Bowen & Walz, engineers. Prof. R. R. Martel, of the California Institute of Technology, was associate consulting engineer for the Hollywood Bowl Association. Credit should be given Lloyd Wright, architect, for the original conception of the shell shape and to Dr. Vern O. Knudsen for the acoustical analysis.

New Vessel Completed for Coast Survey

Recent acceptance by the government of the tender "Westdahl" adds to the fleet of the U. S. Coast and Geodetic Survey a 90-ton vessel measuring 77 ft. long with a 15½-ft beam and drawing 6 ft. of water. This ship is intended for surveying operations in localities unsuited to the larger seagoing vessels, such as inland waters of considerable size and inshore work along exposed coasts. The "Westdahl" has five watertight bulkheads and a double bottom extending the full length of the boat, in which will be carried 14 tons of fuel oil and 6 tons of fresh water. The main engine is an Atlas Imperial direct reversible 140-hp. diesel which will give a speed of ten knots. The home port of this tender is Seattle, Wash. After a preliminary trip this winter covering hydrographic work in the vicinity of Santa Barbara Channel, the vessel will proceed to the Gulf of Alaska for further exploration. The tender is named in honor of Capt. Ferdinand Westdahl, who served with the Coast Survey from 1867 until his death in 1919, commanding a number of its vessels.

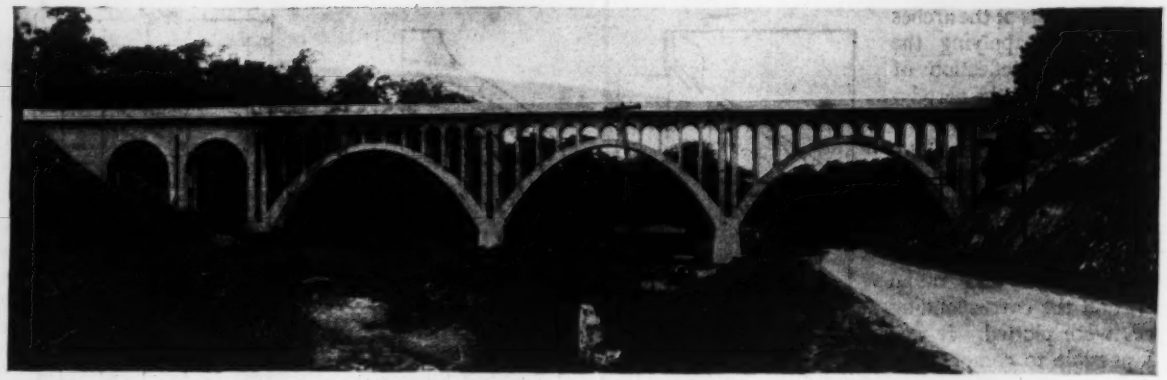


FIG. 1—CONCRETE VIADUCT ON KANSAS CITY SOUTHERN RAILWAY
Viaduct on new line into Kansas City, Mo., crossing a stream and U. S. Highway No. 50. Main arches 95 ft. and 78½-ft. span.

New Line for Kansas City Southern Railway

Improved Approach to Kansas City Reduces Grade From 1.6 to 0.5 Per Cent and Eliminates Many Grade Crossings—Concrete Arch Viaducts Are Handsome Structures

WITH the completion of its 13¼-mile line between Grandview and Leeds, Mo., the Kansas City Southern Railway has entire ownership of the shortest route between Kansas City, Mo., and its Gulf ports at Port Arthur, Beaumont and Orange, Tex., and Lake Charles, La. This new line, 13.27 miles long, with single track, built by the Kansas City & Grandview Railway Co., as a subsidiary, forms a new and improved entrance to Kansas City.

When the Kansas City Southern Railway was completed, in 1897, its own line began at Grandview, Mo., 22½ miles from Kansas City. Trackage rights north to Leeds, Mo., 11 miles, for connection with the terminal railway system, were secured over an existing line of the St. Louis-San Francisco Railway, which afforded sufficient and economical operating facilities. At that time the operating district between Kansas City and Pittsburg, Kan., 128 miles, had a ruling grade of 1 per cent, except that the joint-track line had a grade of 1.6 per cent, 4½ miles long, against southbound traffic. With helper engines for this grade, the district was operated satisfactorily until 1912, when the railroad carried out a grade revision program which gave a maximum grade of 0.5 per cent between Grandview and Pittsburg. With the heavier train loading for the reduced grade, there was increased difficulty in operating over the 1.6 per cent grade on the leased line.

Low-Grade Line—Investigation showed that north of Grandview a new line could be built to conform to the ruling grade on the remainder of the district. In determining upon the construction of this line, one of the deciding factors was the desirability of complete ownership in preference to trackage rights. Furthermore, with the steadily increasing business, this new line offered operating advantages in the elimination of helper engines, the balanced loading of tonnage trains, reduction in curvature and in total rise-and-fall, and freedom from the high-water troubles on the joint line. Construction was started in August, 1928.

The striking difference in the profiles of the new and old lines is shown in Fig. 2. At Leeds, about 10 miles from the Kansas City union station, the line is at El. 775 in the valley of the Big Blue River, while Grandview, 13 miles south, is at El. 1050 on the summit of the ridge between the valleys of the Big Blue and Little Blue rivers. With a difference in elevation of 275 ft. in 13 miles, the average grade is 21.2 ft. per mile, or 0.4 per cent. To secure a ruling grade of 0.5 per cent, compensated for curvature, it was necessary to begin the ascent at Leeds and carry the line up the east side of the valley to the summit at Grandview.

Besides the reduction of ruling grade to 0.5 per cent, the total rise-and-fall is reduced from 422 ft. to 299 ft. and the total curvature from 993 deg. to 638 deg., while the sharpest curves are of 4 deg. instead of 6 deg. and there is a reduction of 321 ft. in total length of these curves. On the new line the grade-crossing situation is much improved, for with 44 crossings in 13¼ miles it has only one public highway grade crossing, seventeen private grade crossings, nine overhead and seventeen subway grade separations. The joint line had seventeen public and private grade crossings, one overhead and one subway grade separation and two railroad grade crossings.

Construction Work—As the grading was the main feature, culvert and bridge work was so planned as to avoid interference with it. This grading, which involved 1,000,000 cu.yd. of common excavation and 450,000 cu.yd. of solid rock, was sublet to a number of contractors in order that it might all be completed by Sept. 20, 1929. On the north end of the line a stratum of clay of varying depths covers a stratified limestone 5 to 10 ft. thick, below which are alternating layers of shale and limestone. Farther south the surface loam overlies these alternating layers. Earth excavation was handled by elevating graders, which loaded wagons mounted on crawlers. Rock was blasted and loaded by power shovels into trucks, wagons and narrow-gage dump cars. Fills were given slopes of 1 on 1½, with a top width of 20 ft. for heights up to 20 ft. and a 22-ft. top for higher fills. Material from the cuts was sufficient to make all fills except the two end fills, for which it was necessary to establish borrowpits.

In cuts, the subgrade width is 26 ft. Earth excava-

tion was taken out at a slope of 1 on 1, as material was needed for the fills. These wide cuts are easier to keep clean, thus saving something in maintenance. Below the earth slopes in cuts, the rock was taken out on slopes of 4 on 1 to 2 on 1. The largest fill contains 405,000 cu.yd. and has a maximum height of 65 ft., with a 30-ft. concrete arch culvert 135 ft. long for Round Grove Creek. The largest cut, with a depth of more than 70 ft., contained 119,000 cu.yd., of which 71,000 cu.yd. was solid rock.

Bridges and Culvert—Two reinforced-concrete viaducts and a steel viaduct are the three principal structures. At each of these locations a highway and a waterway had to be crossed, and no excavation from cuts was available for making a fill. Concrete-pipe culvert work was sublet to a contractor who handled the excavation, made the pipe at the site, placed the pipe and built the headwalls. These drainage openings vary from a single 24-in. pipe to a pair of 66-in. pipes, according to the drainage areas and local conditions. The longest culvert, 360 ft., is of the double-pipe type.

All subways have concrete abutments and steel girders carrying a deck slab for ballasted track, except that a creosoted-pile trestle crosses the spur track to the Municipal Farm. Of highway bridges crossing the railroad, six are of treated timber and three are of concrete and steel.

Steel Viaduct—This is the largest of the three main structures, crossing the valley of a tributary of the Big Blue River, with a length of 875 ft. and a maximum height of 110 ft. above the ground. It is a deck plate-girder viaduct with nine spans of 50 to 65 ft. 8 in. and eight tower spans of 38 ft. Concrete is used for the abutments and tower pedestals. A concrete deck slab on the girders carries the ballasted track.

After clearing the ground the foundations were excavated roughly with a dragline machine and finished by handwork. Concrete for the pedestals and abutments was mixed at each end of the structure and chuted into place. All of these are founded on solid rock, except that piling was used at three of the towers. Steel was brought to the north end of the viaduct by company trains, the new line being completed to that point, and was erected by a derrick car capable of handling a 65-ft. girder without outrigging or blocking. Concrete for the deck slab was mixed at the north end of the viaduct and placed in the forms by means of a hopper dump car handled by a motor car on a temporary track.

FIG. 3—ERECTING STEEL VIADUCT, KANSAS CITY SOUTHERN RAILWAY

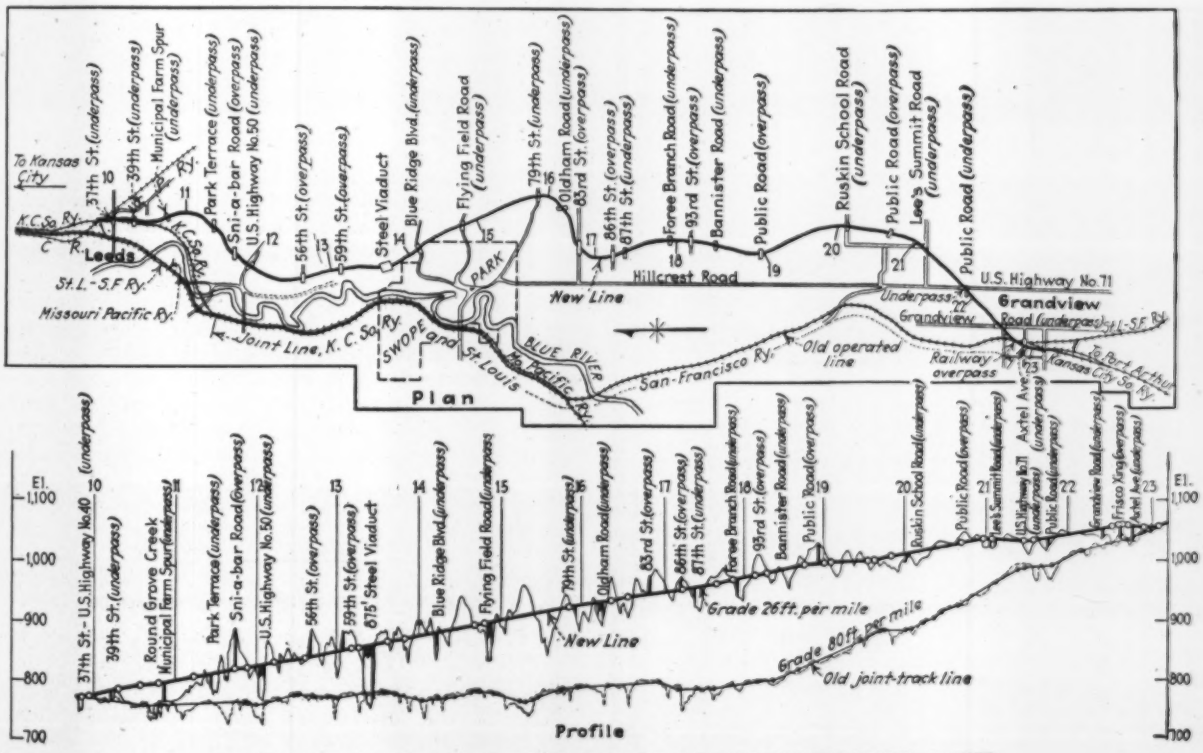


FIG. 2—KANSAS CITY SOUTHERN RAILWAY'S NEW LINE INTO KANSAS CITY

This track was used also for distributing ties and rails. Along each side of the deck is a concrete walk with pipe hand railing. Steel was erected and the slab completed in six weeks. This viaduct contains 1,000 tons of structural steel and 2,200 cu.yd. of concrete.

Reinforced-Concrete Viaduct—The two arch viaducts crossing U. S. Highway No. 50 and Flying-Field Road (shown in Figs. 1 and 4) are of similar design, but the latter has three approach arches at each end. This Flying-Field Road viaduct, 504 ft. long and with its rails 65 ft. above the stream, has one 95-ft. and two 78¾-ft. spans of the barrel-arch open-spandrel type, flanked at both ends by one 34-ft. arch, two 31½-ft. arches and a 31-ft. girder span. All footings are on solid rock. Earth excavation for the foundations was handled by a power shovel, and rock work was done by hand. A concrete-mixing plant with automatic material-measuring devices and a 120-ft. steel hoisting tower was installed and concrete distributed to the forms by means of counterbalanced chutes (see Fig. 4). About 2,750 cu.yd. of concrete was required.

Forms for the piers and abutments were of 1-in. dressed lagging on 2x6-in. studding, with wales built up of 2-in. material. On the under side of the arch rings, however, the lagging was of 2-in. dressed lumber. The centering for the three main spans was built up with 10x10-in. fir timbers as the main supports. Before this centering was placed concrete was poured in the piers up to the haunch or springing line of the arches. Each arch ring was divided into five sections for pouring. The top section, about 30 ft., was poured first; then the two lower sections adjoining the piers were placed simultaneously, after which the two key sections were poured.

At least 48 hours was required between the pouring of any adjoining sections, to permit the concrete to get its maximum shrinkage at the upper headers.

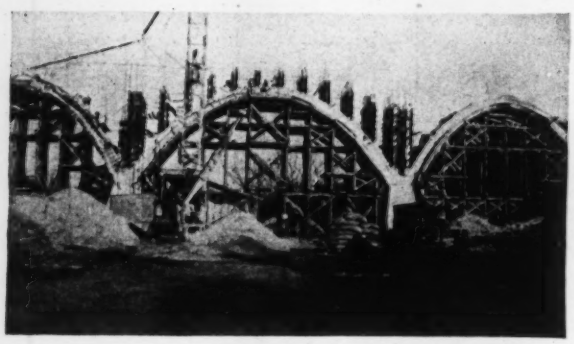


FIG. 4—CONCRETING VIADUCT OVER FLYING-FIELD ROAD

Construction joints were placed only at points specified by the plans, which necessitated 48-hour continuous pouring of certain sections. This involved pouring some concrete at temperatures near zero, but in such cases all aggregates and water were preheated and the concrete in place was protected with canvas covering and salamander heaters.

Track Construction—A heavy type of track is laid, consisting of 127-lb. rails spliced with 38-in. six-bolt angle bars. Double-shoulder tie-plates, 7x12 in., give the rails an inward cant or inclination of 1 on 20 and are spiked to treated ties 7x9 in. and 8 ft. long, spaced 3,000 per mile. At present the line is ballasted with sand 12 in. deep under the ties, but broken stone ballast will be laid when the roadbed has become compacted under traffic. Two passing tracks 1 mile long, two emergency spurs and one industry siding have been built and are laid with 85-lb. relay rails. The passing tracks have No. 12 turnouts laid with 22-ft. switch rails, 24-ft. rigid railbound manganese-steel frogs having raised wing rails, and 8½-ft. one-piece manganese-steel guard rails. Turnouts for the industry track have 19½-ft. switch rails and No. 10 frogs 16½ ft. long. All mile posts, rail rests and other markers are constructed of concrete.

Engineers and Contractors—A general contract for

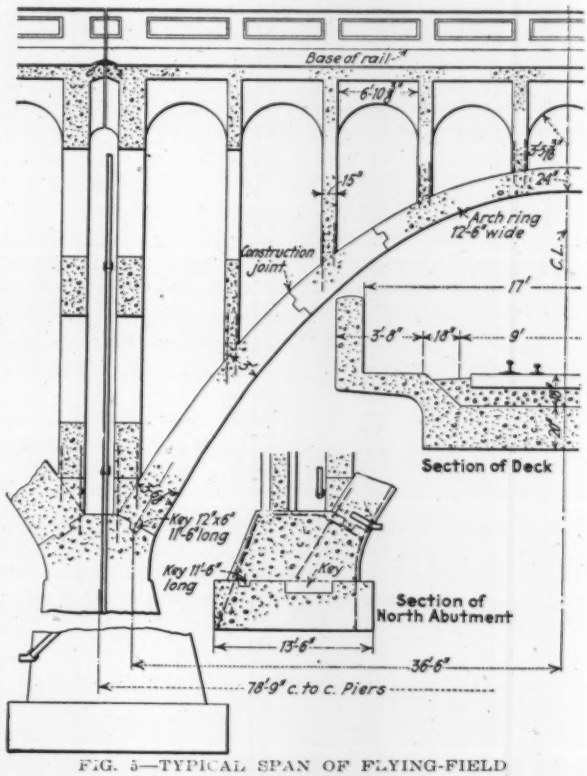


FIG. 5—TYPICAL SPAN OF FLYING-FIELD ROAD VIADUCT

grading, bridging and culverts was awarded to the List Construction Co., Kansas City, Mo. Tracklaying, surfacing and telegraph line work were handled by the railway forces. This project was planned and built under the direction of A. N. Reece, chief engineer of the Kansas City Southern Railway, and its construction was under the direct supervision of E. M. Basye, resident engineer, with P. J. McCarthy and E. N. Durham as assistant engineers. For the structures, the designing engineers were Ash, Howard, Needles & Tammen, of Kansas City Mo., and C. S. Heritage, bridge engineer of the Kansas City Southern Railway. The new line, costing about $3,300,000, was opened to traffic on Nov. 21, 1929.

Timber Truss Bridges—Correction

In the article on the timber truss highway bridge over the Fraser River in *Engineering News-Record* of Jan. 30, p. 186, the expected life was given as twenty years, but should have been thirty years, in accordance with the general life expectancy of such bridges, as mentioned in the same article.

Current Changes in British Sewage-Works

Chemical Precipitation, Land Treatment and Contact Beds Continue to Give Way to Sedimentation and Trickling Filters—Activated-Sludge Process Forges Ahead With Three Methods of Activation

By M. N. Baker
Associate Editor, Engineering News-Record

TWENTY-FIVE YEARS ago, on my first visit to England, chemical precipitation and land treatment, long dominant there, were giving way to the septic tank and contact bed, and the contact bed itself was yielding to the trickling filter. The first Travis hydrolytic or two-story septic tank, which separated the double function of clarification and sludge digestion, was under construction at Hampton. In the next few years the changes mentioned went on apace, except that the Travis tank gained very little footing in England; and the Imhoff tank, which grew from it in Germany, still less. Practically the only Imhoff tank in England is a small installation at Manchester, built in 1924. Instead of the two-story tank coming into wide use in England as it did in most other countries, there was a swing back to plain sedimentation, doubtless stimulated by John D. Watson's large installation of plain settling and separate sludge-digestion tanks at Birmingham.

At that same time in America, where chemical treatment never gained a real footing and sewage farming has rarely been used except in the arid and semi-arid West, the septic tank was being adopted rapidly in 1904, but the contact bed had little more than got started when it was swept aside for the trickling filter. Unlike England, America has made wide use of the Imhoff tank from its inception to the present day.

Sewage treatment continued in about the way outlined in both Great Britain and the United States until the introduction of the activated-sludge process fifteen years ago. In size of plants, percentage of sewage treated, completeness of treatment and probably in numbers, the United States and Canada have outranked England from the start as regards this process. Doubtless the deadening hand of the War held England back; also the fact that adoption there of any new process of sewage treatment was more often a matter of building over or adding to existing sewage-works than starting in with a free hand, as has generally been the case in the United States.

Sewage Utilization Declining

Utilization of sewage has lost much ground in England and made some net gain in America in the last two or three decades. Economically, abandonment of sewage farms and of sludge utilization in England has probably been a decided gain. In America, and to a less degree in England, it is yet to be shown by application of commercial accounting how much any attempt to utilize sewage or its products has reduced the net cost of sewage disposal. So far as learned, no British city has attempted (or now proposes) to utilize excess sludge from the activated-sludge process. Most British cities have given up making fertilizer from the sludge of any other process.

More progress in utilizing gas collected from sludge-digestion plants seems to have been made in England than in the United States or Canada. Results from this on both sides of the Atlantic seem promising, but adequate cost data are lacking.

Manufacturers of equipment used in sewage treatment and contractors interested in promoting the adoption of some more or less proprietary apparatus or process seem to play far more part in England than in America. The extent to which this is detrimental is uncertain, but apparently it tends to deprive British cities of the benefits of a disinterested engineering study to determine what kind of treatment or apparatus is best suited to local needs.

British sewage-works are generally in charge of the city engineer, or of a department engineer in the larger places, and it is common to find long tenure of office of these engineers, as well as of sewage-works managers with or without technical training.

Although a large part of British municipalities treat their sewage—nearly all except those on tidal waters—many of the treatment works are antiquated and otherwise inadequate. Where newer and more complete processes are used, these are likely to serve only a part of the city. Notable progress in covering entire cities is being made; the lag is still largely attributable to war and post-war conditions.

Activated Sludge to the Fore

The activated-sludge process is the center of interest in England, as it is in America, because it is still in a state of change. In America most of the activated-sludge plants, and all the larger ones, use air diffusion for activation. In England mechanical agitation is a strong rival. Despite a dozen years of activated sludge there is still much to be learned as to the best methods of both design and operation, including choice of activation methods, depth of tanks, length of activation period, air volumes and mechanical agitators.

In England activation is quite generally only one element in a system of treatment, particularly in the older and larger works, whereas with us most activated-sludge plants are designed and operated to give the

A Quarter-Century's Progress

Significent changes have affected the practices of sewage treatment in Great Britain in the 25 years just concluded. Mr. Baker, who first studied that country's sewage-treatment plants in 1904 and whose widely known book "British Sewage-Works" recorded the results of his examination, now tells of the developments that have affected the chief city works in the quarter-century, as learned in a visit to the more important works a few months ago.

—Editor.

full degree of treatment required. In England adopting the process as one of partial treatment seems to come about through fitting it into an existing plant; for instance, at Birmingham activation will be used to lessen the work of trickling filters. Practice in both countries tends to agree through an increasing use of pretreatment and, less frequently, after-treatment. Thus again does history repeat itself; in this case by a return to a division of labor.

In the notes that follow I first give interviews with some well-known authorities on sewage treatment, then report and comment on what I saw and heard at a number of plants in July and August.

A Few Interviews

H. T. Calvert — Thoroughly informed regarding sewage-treatment practice in Great Britain and well known to American engineers who visit British sewage-works is Dr. H. T. Calvert, chief chemical inspector to the Ministry of Health. He urged that because Birmingham, Manchester, Sheffield, Reading and other places have abandoned other methods of treatment for the activated-sludge process it should not be thought that all cities in England and Wales are doing the same. Leicester and Bradford are installing large areas of trickling filters. Nottingham is putting in sedimentation tanks to lighten the burden on its sewage farm. Of places from 15,000 to 20,000 population now building or extending sewage-works, more are putting in percolating filters than activated-sludge plants. After a lull of two years in adoption of the activated-sludge process, recently several projects have come before the Ministry of Health for sanction, including plants for Exeter and Derby (60,000 and 145,000). There is no choice between the three methods of sludge activation—air, paddlewheels and the "simplex" system, so far as physical and biological results go. Studies to determine relative costs are needed.

A. J. Martin—One of the best-known sewage-works engineers in Great Britain, Arthur J. Martin, of London, has changed his conclusions on the activated-sludge process somewhat since he wrote his large book in 1927. He now favors presedimentation. He thinks somewhat less of diffused air for activation and more of mechanical agitation than formerly. Where air is used, he is not so favorable now as then to the spiral-flow method of air diffusion, in which all the diffusers are placed at one side of the channel. Instead, he now favors the original multiridge-and-furrow method, with diffusers in each furrow.

John D. Watson—In answer to a question as to the relative standing, in his opinion, of the three current methods of activation, John D. Watson, consulting engineer, Birmingham, put diffused air first, the Haworth paddlewheel second and the "simplex" method third. In a 10,800,000-gal. daily (10.8 m.g.d.) plant which he is designing for Bombay, India, diffused air will be used unless something unforeseen occurs. The plant will treat up to four times the dry-weather flow, or 43.2 m.g.d. Wet sludge will be delivered to farmers, who are accustomed to wet manuring of their crops. Sewerage districts will increase in England. The Birmingham, Tame and Rea district is the largest one in existence. Although more than 50 years old, it stands almost alone. Mr. Watson has reported to the Middlesex County Council on a joint project which would substitute one or two sewage-treatment plants for the 27 now operated by various municipalities. The activated-sludge process, with air diffusion, is proposed, preceded by sedimentation. Surplus sludge would probably be barged to sea. The effluent would go into the tidal portion of the Thames below the London water intakes. Effluent from six of the plants now in use is discharged into the river or its tributaries above the intakes.

Mrs. E. M. Mumford — Mrs. Mumford, fellow-worker with the late E. M. Mumford, of the University of Manchester, is actively associated with the London organization that installs activated-sludge plants of the air-diffusion type. There is a tendency now, Mrs. Mumford said, to use presedimentation in the activated-sludge process, while for a very strong sewage preaeration might be used before presedimentation. She showed me tentative plans for a combination of preaeration, presedimentation, activation and secondary sedimentation.

Notes on Various Installations

Manchester—Among several large cities that were making radical changes in their sewage-works 25 years ago and are now engaged in further radical changes is Manchester. It was here, in the years between, that Dr. Gilbert J. Fowler, Edward Ardern, William T. Lockett and others developed the activated-sludge process, after Dr. Fowler had witnessed a laboratory experiment with forced aeration at the Lawrence Experiment Station of the Massachusetts State Board of Health. In 1904 Manchester was changing from chemical precipitation to sedimentation and contact beds at the Davyhulme or main works, while land treatment was still in use at the smaller or Withington plant—to be given up later for sedimentation and contact beds. In 1929 Manchester had in use or under construction plants to treat all of its sewage by the activated-sludge process.

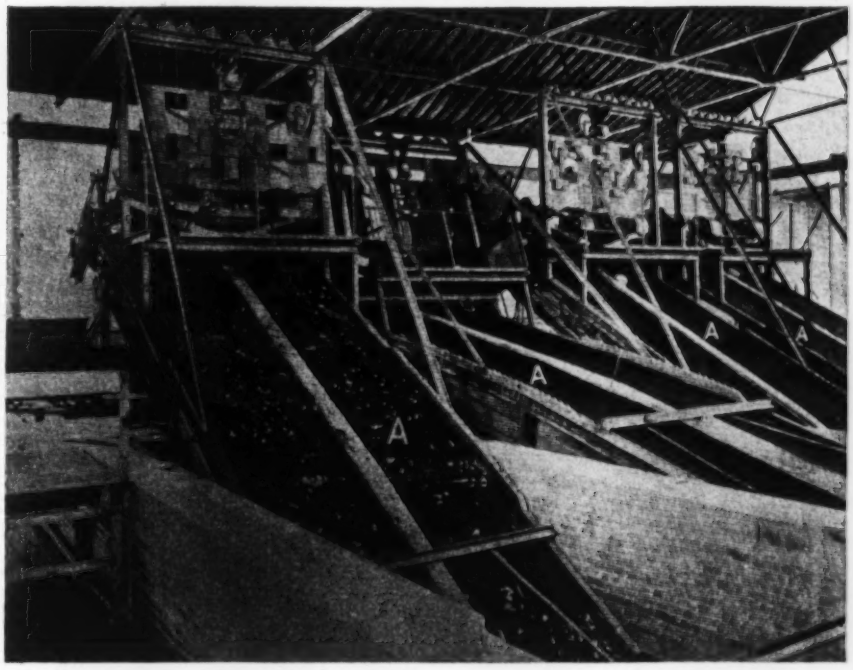
The Davyhulme plant treats the sewage of 760,000 people, which totals less than 70 m.g.d., or about 80 gal. per capita. The population tributary to the Withington plant is 75,000 and the average volume treated is under 6 m.g.d. (Throughout this article, United States gallons are used; to convert to British or imperial gallons, deduct one-sixth.) It was at Withington that the activated-sludge process was first tried out on a working basis. In 1917 the first continuous-flow plant was built; in 1925 a large one was added, and since then the change to the activated-sludge process has been completed. Meanwhile tests on many variations in air-diffusion were made, including spiral-flow. Two Imhoff tanks built at Withington in 1924—almost if not quite the only ones in Great Britain—were still in use in 1929.

In September, 1925, the Ministry of Health authorized new construction at the Davyhulme works, consisting of a detritus tank and screening chamber, activated-sludge units to treat half the dry-weather flow and the required proportionate stormflow, and a sludge main 2½ miles long to lands owned by the city, all at an estimated cost of £500,000, or $2,425,000. The sludge main was put into use in 1928; the detritus chamber and screens were in operation in July, 1929, and activated-sludge units to treat half the sewage flow were under construction, as also two small units. The larger element of the new plant will treat 19.2 m.g.d. with air diffusion from a ridge-and-furrow bottom. Of the smaller units now under construction, each of 1.2-m.g.d., one is of the Haworth vertical paddle-wheel type and the other of the "simplex" or horizontal-wheel and suction-tube type, both relying on mechanical

agitation instead of compressed air for activation.

On reaching Davyhulme the sewage passes through grit chambers and inclined screens. The latter are of a new type, consisting of small wire rope. A brush at the top removes the screenings. The activated-sludge plant will receive sewage that has passed through these screens and the detritus tanks, but whether additional pretreatment will be given, and if so what, had not been announced in July, 1929. The final effluent will continue to be discharged into the Manchester Ship Canal.

Most of the sludge produced at the Davyhulme works has been shipped to sea. Some has been made into "sludge manure," but owing to the state of the fertilizer market this has been stopped, although the plant is held for possible future use. The sludge main already mentioned will give an alternative method of sludge disposal.



TRAVELING ROPE BAND SCREENS AT DAVYHULME SEWAGE-WORKS MANCHESTER, ENGLAND

Each of the four screens (marked *A*) is 41 ft. long and has an effective width of 8 ft. Each screen has four $\frac{3}{4}$-in. steel wire ropes which, passing over pulleys, form 55 turns in each rope, giving $\frac{1}{2}$-in. clearance. Normal running speed is 3 ft. per minute, but this can be increased to 12 ft. Each screen is operated independently by 2-hp. motors. —From 1928-29 report of Manchester Rivers Department.

Sheffield—Under the direction of John Haworth, chemist and manager of its sewage-works, Sheffield is replacing 46 acres of contact beds by an activated-sludge plant in which activation is effected by paddle-wheels named after Mr. Haworth, their designer. Before activation the sewage is pretreated.

Mr. Haworth still has on exhibit laboratory apparatus used by him in 1914 to lift sewage up or force it down, at will, through a tube, for aeration. He said that he had blown air through sewage long before that —as had many others. (For his early studies see "Experimental Work With Reference to Purification of Sewage by Aeration, Activated Sludge, etc.," a paper read July 8, 1916, before the Association of Sewage Works Managers; given in *Municipal Engineering*, London, July 20, 1916.)

The first Haworth paddlewheels were installed in activation channels at Sheffield in 1920. Their capacity was 0.6 m.g.d. They have never stopped since. Repairs on them have cost less than £10 (under $50). Another unit has been in use six years, with no repairs. There are now in operation seventeen units, each of 1.2-m.g.d. capacity, which are taking practically all the dry-weather flow of the city, save that treated at a small works elsewhere. Four additional units of the same size are under construction. These will bring the dry-weather capacity to 25.2 m.g.d. The population tributary to this works is 510,000, giving a dry-weather flow of 21.6 to 26.4 m.g.d., of which a third is trade wastes. The most troublesome wastes are those from the gas-works, breweries and iron puddling.

On arrival at the plant the sewage passes through grit chambers, mechanically cleaned bar screens and settling tanks, then to the various activation units. Each unit consists of a series of narrow channels in which are Haworth paddlewheels. The channels are 6 ft. wide by some 200 ft. long and have a combined length of about a mile. The normal sewage depth is about $3\frac{1}{2}$ ft., which may be increased to give higher rates of treatment. The channels communicate around their ends, where the walls are gradually thickened and curved to prevent dead water—the shape having been determined by test models. There is a paddlewheel midway the length of each channel. These wheels, or at least the later ones, are all steel, 10 ft. in diameter, with eight sets of spade-shaped paddles, two in a set, the paddles in each set being 2 ft. from each other, and each paddle being 2 ft. from the nearest side wall. The paddles and the swelled ends of the walls give a strong wave action through the entire length of the channels and notably around the ends. Settled effluent is discharged into the River Don.

After drying on beds, the sludge is shipped 6 miles by rail and dumped in a 33-acre colliery pit, where the ground has settled. Some $1\frac{3}{4}$ million long tons have been dumped there. When the dumped sludge has dried, grass or other crops are grown upon it.

Advantages claimed by Mr. Haworth for the type of activation plant there used are: a minimum of space required, only three-fourths of that used by filters; all machinery operated at low speed; no orifices less than 4 in. in diameter to clog. Any city is free to use the Haworth paddlewheels.

Birmingham—The sewage-works of the Birmingham, Tame and Rea Drainage District, with its area of 107 square miles, illustrates the march of sewage treatment in Great Britain. Chemical precipitation was the first method used, supplemented later on by land treatment on an immense area. In time chemical precipitation and the sewage farm were given up for plain sedimentation and separate sludge digestion, trickling filters and humus tanks. Now an activated-sludge plant is

being inserted between the primary settling tanks and filters, doubling the capacity of the latter. Some of the old sewage farm has been sold for industrial plant sites and some leased to farmers. The main works serves about 1,000,000 people and treats an average dry weather flow of nearly 40 m.g.d. For an additional 100,000 population there is a plant at Cole Hill, consisting of settling tanks and trickling filters, with enough sludge digestion to produce gas for works purposes. The separate sludge-digestion tanks at the main works are gradually being provided with gas-collection domes and the gas utilized for works purposes. The digested sludge, once forced to land, distributed by furrows and plowed under, now goes to sludge-drying beds.

These almost revolutionary changes were begun and

Sludge from the digestion tanks passes to drying beds. Of some 30,000 long tons of sludge produced yearly, about 6,000 are sold to a fertilizer manufacturer.

Activated-sludge installations with a combined capacity of 9 m.g.d. are already in use at these Birmingham works and a 12-m.g.d. installation is under construction. Both installations are classed in England as giving partial treatment only, since—in this case—they receive presettled sewage and pass it on to trickling filters. The existing activated-sludge installation employs diffused air in the activation tanks for the most part, but there is also a small installation of paddlewheels set on an inclined axis. These are called "Hartley" wheels, and appear to be in use in only one other place, Stoke-on-Trent. The wheels at Birmingham had solid or con-

GAS CALLECTORS ON SLUDGE-DIGESTION TANK OF SEWAGE-WORKS OF BIRMINGHAM, ENGLAND
Reinforced-concrete rafts support domes to which gas-collecting pipes are connected. Note proximity of housing development in background.

carried well on toward their present state by John D. Watson, for many years engineer to the board named, and have been continued by his successor, H. C. Whitehead, formerly assistant to Mr. Watson. Already the Birmingham works not only produces a good effluent but also, Mr. Whitehead declares, gives the "most complete sludge treatment on the largest scale to be found in England." The achievements will be all the more notable when the activated-sludge plant is completed.

After passing through grit chambers, the sewage from 1,000,000 people goes to plain sedimentation tanks, designed to give equalization of both the volume and the strength of sewage, which fluctuate widely, especially in strength. The sludge from these tanks passes to seven digestion tanks, some of which are provided with raft-supported gas-collection domes, of precast reinforced concrete. Additional tanks now being similarly equipped will provide all the gas needed for works purposes, it is expected. Should a market be found for the methane gas (which forms a large part of the gas collected) then all the digestion tanks might be equipped with gas domes. During at least a part of July, 1929, 95 per cent of the power used to pump sewage and for other works purposes was produced from the sludge gas. The gas is supplied to gas engines, one of 150 and another of 400 hp., which drive electric generators. Current is bought when necessary.

tinuous vanes at first but have been changed to paddle form. For reconditioning sludge, the Bolton or "simplex" agitation method is used. In the new 12-m.g.d. plant diffused air will be used, a decision reached after trying both it and mechanical agitation.

Reading—The first British town of considerable size to build an activated-sludge plant designed to give complete treatment to practically all of its sewage was Reading, a place of some 85,000 population. The plant is still the largest one in England giving "complete treatment" on the diffused-air system, but is exceeded in size by a number of "partial-treatment" plants. The Reading works went into use in 1925. It was expected that it would treat the entire dry-weather flow of sewage, about 3.3 m.g.d., but according to H. Wilson, chemist of the works, the plant was handling a dry-weather flow of about 1.8 m.g.d. in 1929, or half the total. The remainder goes to a sewage farm, established years ago. The causes given for the lesser capacity than was expected are: (1) strength of the sewage and its large percentage of wastes from the municipally owned gas works; (2) excessive depth of the activation tanks. Presedimentation tanks are being built.

Reading is sewered almost entirely on the separate system. Nearly all the sewage that reaches the works under consideration is pumped from a station located at about the center of the town. Sewage from some

10,000 population on the Oxford side of the river is treated by tanks and contact beds built 25 years ago.

The sewage treated by the activated-sludge process passes through bar screens at the pumping plant and through a second set of bar screens and also grit chambers at the treatment works. The flow is indicated by a Venturi meter. The working depth of the aerating tanks is about 22½ ft. Air is used after compression to 11 lb. at a rate of 0.8 cu.ft. per Imperial gallon (about 0.7 ft. per U. S. gallon). Bubbles of gas, Mr. Wilson states, adhere to the particles of sludge and cause "bulking," or slowness of settlement, and high moisture content. Sometimes sludge rises to the surface. This is on highly nitrified sludge.

To remove the effects of the gas wastes, 20 to 24 hours of aeration is given. The effluent is well clarified but retains some of the brownish tinge given by the gas liquor. Surplus sludge is sometimes produced, at the rate of 0.25 m.g. to each 1 m.g.d. of sewage treated. In the earlier days of these works the excess sludge was put on drying beds, which produced an odor noticeable a long distance from the beds. It is now pumped to earth-sided beds from which the water is decanted. After about a week the sludge, reduced by one-seventh to one-tenth in volume, is lagooned to a depth of about 3 ft. in 30x100-ft. beds. These beds are covered with weeds to keep down odor.

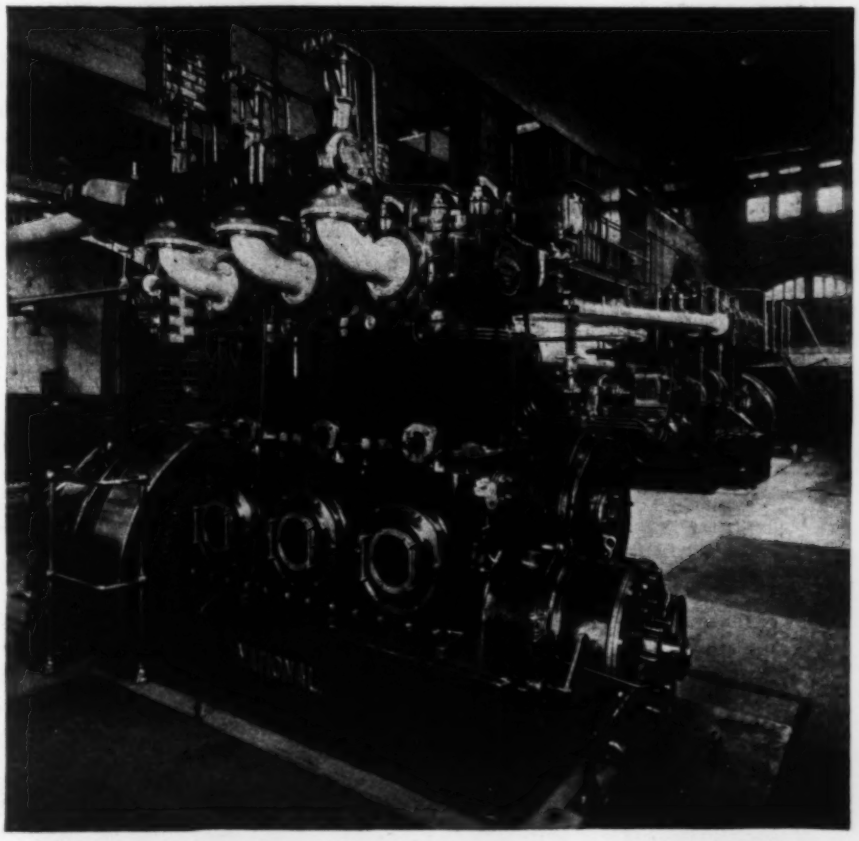
The presedimentation tanks will serve to equalize both the volume and the strength of the sewage entering the activated-sludge plant. Already the gas wastes are partly equalized by tank retention at the gas works, which adjoins the pumping station. The surplus sludge from the plant will be returned to the inlet end of the new presedimentation tanks. Separate sludge digestion tanks may be provided later, but this has not been determined. The existing sludge re-activation tanks, which have a working depth of 20 ft., will be used as supplementary activated-sludge plants, for which presedimentation will be provided.

The aerating tanks of the original activated-sludge plant at Reading were of the spiral-flow type, but half of them were changed to the ridge-and-furrow plan. Mr. Wilson said that it is a toss-up which method of diffusion is the better; both will be used in the new plant.

Bury — The sewage-works of Bury is notable for the development there of the "simplex" variation in the activated-sludge process, put into practical working form by Joshua Bolton, works manager. The first unit of this plant was started up in March, 1925. Mechanical agitation is used, effected by horizontal revolving wheels working in an inverted flat truncated cone, resting on a tube shaped like a truncated cone, which does not quite reach to the bottom of the activation tank. The action of the wheel sucks sewage up through the tube and discharges it rather violently at the surface, not only giving wave action but also throwing some of the sewage into the air and creating white patches of foam.

Bury is an industrial town of 58,000 population. Its present dry-weather sewage flow is 2.4 m.g.d., but full treatment is given up to three times this flow and partial treatment to stormwater in excess of three and up to six times the dry-weather flow. The plant was designed to treat 1.2 m.g.d. and did so in 1925-26. Since then the municipally owned gas works has discharged 7,000 g.d. of wastes into the sewers, cutting down to 0.9 m.g.d. the amount of sewage treated by the activated-sludge process. Besides gas wastes, the sewage contains brewery, tannery, bleachery and dye wastes, but only the dye and gas wastes make trouble, and the latter only when charged with potassium chromate. The gas wastes reduce the quality of the effluent by 30 per cent, according to Walter Scott, chemist of the works.

All the Bury sewage was passed through grit chambers, inclined bar screens, settling tanks and trickling filters before the activated-sludge process was introduced, and part of it still is, including that subjected to activation. The activation tanks are 9 ft. deep. Each alternate agitation wheel works in a direction opposite to the next one. The wheels are driven by shaft and gear, and use from 22 to 25 hp. (for some 0.9 m.g.d.). Excess sludge is pumped to and mixed with crude



GAS ENGINES OPERATED BY GAS FROM SLUDGE-DIGESTION TANKS, SEWAGE-WORKS OF BIRMINGHAM, ENGLAND

A 450-hp. and a 156-hp. installation.

being inserted between the primary settling tanks and filters, doubling the capacity of the latter. Some of the old sewage farm has been sold for industrial plant sites and some leased to farmers. The main works serves about 1,000,000 people and treats an average dry weather flow of nearly 40 m.g.d. For an additional 100,000 population there is a plant at Cole Hill, consisting of settling tanks and trickling filters, with enough sludge digestion to produce gas for works purposes. The separate sludge-digestion tanks at the main works are gradually being provided with gas-collection domes and the gas utilized for works purposes. The digested sludge, once forced to land, distributed by furrows and plowed under, now goes to sludge-drying beds.

These almost revolutionary changes were begun and carried well on toward their present state by John D. Watson, for many years engineer to the board named, and have been continued by his successor, H. C. Whitehead, formerly assistant to Mr. Watson. Already the Birmingham works not only produces a good effluent but also, Mr. Whitehead declares, gives the "most complete sludge treatment on the largest scale to be found in England." The achievements will be all the more notable when the activated-sludge plant is completed.

After passing through grit chambers, the sewage from 1,000,000 people goes to plain sedimentation tanks, designed to give equalization of both the volume and the strength of sewage, which fluctuate widely, especially in strength. The sludge from these tanks passes to seven digestion tanks, some of which are provided with raft-supported gas-collection domes, of precast reinforced concrete. Additional tanks now being similarly equipped will provide all the gas needed for works purposes, it is expected. Should a market be found for the methane gas (which forms a large part of the gas collected) then all the digestion tanks might be equipped with gas domes. During at least a part of July, 1929, 95 per cent of the power used to pump sewage and for other works purposes was produced from the sludge gas. The gas is supplied to gas engines, one of 150 and another of 400 hp., which drive electric generators. Current is bought when necessary.

Sludge from the digestion tanks passes to drying beds. Of some 30,000 long tons of sludge produced yearly, about 6,000 are sold to a fertilizer manufacturer.

Activated-sludge installations with a combined capacity of 9 m.g.d. are already in use at these Birmingham works and a 12-m.g.d. installation is under construction. Both installations are classed in England as giving partial treatment only, since—in this case—they receive presettled sewage and pass it on to trickling filters. The existing activated-sludge installation employs diffused air in the activation tanks for the most part, but there is also a small installation of paddlewheels set on an inclined axis. These are called "Hartley" wheels, and appear to be in use in only one other place, Stoke-on-Trent. The wheels at Birmingham had solid or continuous vanes at first but have been changed to paddle form. For reconditioning sludge, the Bolton or "simplex" agitation method is used. In the new 12-m.g.d. plant diffused air will be used, a decision reached after trying both it and mechanical agitation.

GAS CALLECTORS ON SLUDGE-DIGESTION TANK OF SEWAGE-WORKS OF BIRMINGHAM, ENGLAND
Reinforced-concrete rafts support domes to which gas-collecting pipes are connected. Note proximity of housing development in background.

Reading—The first British town of considerable size to build an activated-sludge plant designed to give complete treatment to practically all of its sewage was Reading, a place of some 85,000 population. The plant is still the largest one in England giving "complete treatment" on the diffused-air system, but is exceeded in size by a number of "partial-treatment" plants. The Reading works went into use in 1925. It was expected that it would treat the entire dry-weather flow of sewage, about 3.3 m.g.d., but according to H. Wilson, chemist of the works, the plant was handling a dry-weather flow of about 1.8 m.g.d. in 1929, or half the total. The remainder goes to a sewage farm, established years ago. The causes given for the lesser capacity than was expected are: (1) strength of the sewage and its large percentage of wastes from the municipally owned gas works; (2) excessive depth of the activation tanks. Presedimentation tanks are being built.

Reading is sewered almost entirely on the separate system. Nearly all the sewage that reaches the works under consideration is pumped from a station located at about the center of the town. Sewage from some

10,000 population on the Oxford side of the river is treated by tanks and contact beds built 25 years ago.

The sewage treated by the activated-sludge process passes through bar screens at the pumping plant and through a second set of bar screens and also grit chambers at the treatment works. The flow is indicated by a Venturi meter. The working depth of the aerating tanks is about 22½ ft. Air is used after compression to 11 lb. at a rate of 0.8 cu.ft. per Imperial gallon (about 0.7 ft. per U. S. gallon). Bubbles of gas, Mr. Wilson states, adhere to the particles of sludge and cause "bulking," or slowness of settlement, and high moisture content. Sometimes sludge rises to the surface. This is on highly nitrified sludge.

To remove the effects of the gas wastes, 20 to 24 hours of aeration is given. The effluent is well clarified but retains some of the brownish tinge given by the gas liquor. Surplus sludge is sometimes produced, at the rate of 0.25 m.g. to each 1 m.g.d. of sewage treated. In the earlier days of these works the excess sludge was put on drying beds, which produced an odor noticeable a long distance from the beds. It is now pumped to earth-sided beds from which the water is decanted. After about a week the sludge, reduced by one-seventh to one-tenth in volume, is lagooned to a depth of about 3 ft. in 30x100-ft. beds. These beds are covered with weeds to keep down odor.

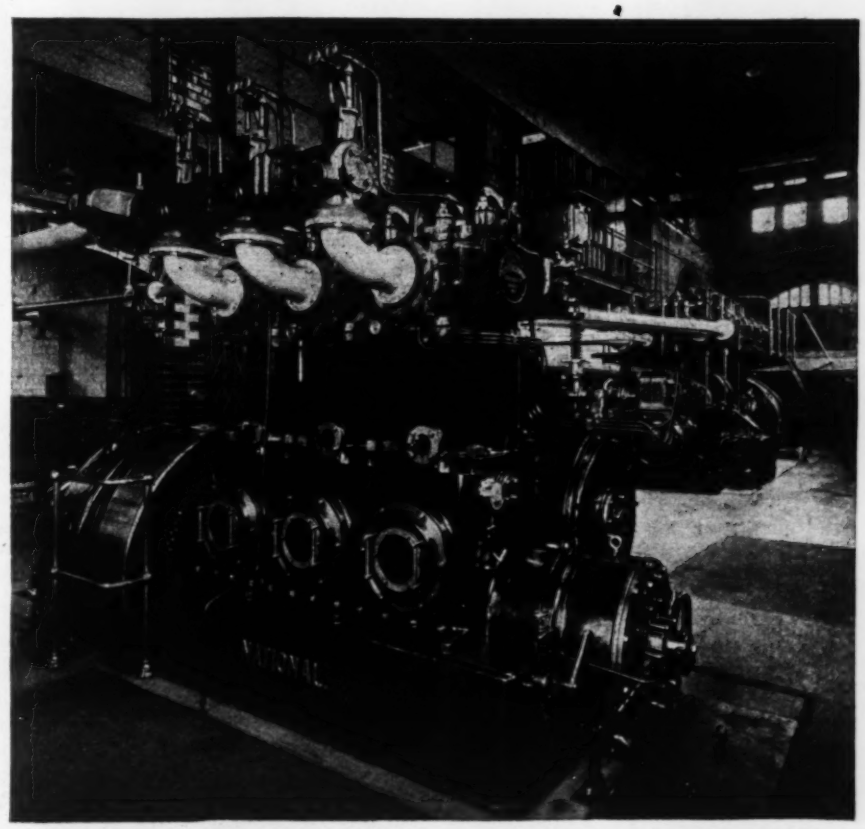
The presedimentation tanks will serve to equalize both the volume and the strength of the sewage entering the activated-sludge plant. Already the gas wastes are partly equalized by tank retention at the gas works, which adjoins the pumping station. The surplus sludge from the plant will be returned to the inlet end of the new presedimentation tanks. Separate sludge digestion tanks may be provided later, but this has not been determined. The existing sludge re-activation tanks, which have a working depth of 20 ft., will be used as supplementary activated-sludge plants, for which presedimentation will be provided.

The aerating tanks of the original activated-sludge plant at Reading were of the spiral-flow type, but half of them were changed to the ridge-and-furrow plan. Mr. Wilson said that it is a toss-up which method of diffusion is the better; both will be used in the new plant.

Bury — The sewage-works of Bury is notable for the development there of the "simplex" variation in the activated-sludge process, put into practical working form by Joshua Bolton, works manager. The first unit of this plant was started up in March, 1925. Mechanical agitation is used, effected by horizontal revolving wheels working in an inverted flat truncated cone, resting on a tube shaped like a truncated cone, which does not quite reach to the bottom of the activation tank. The action of the wheel sucks sewage up through the tube and discharges it rather violently at the surface, not only giving wave action but also throwing some of the sewage into the air and creating white patches of foam.

Bury is an industrial town of 58,000 population. Its present dry-weather sewage flow is 2.4 m.g.d., but full treatment is given up to three times this flow and partial treatment to stormwater in excess of three and up to six times the dry-weather flow. The plant was designed to treat 1.2 m.g.d. and did so in 1925-26. Since then the municipally owned gas works has discharged 7,000 g.d. of wastes into the sewers, cutting down to 0.9 m.g.d. the amount of sewage treated by the activated-sludge process. Besides gas wastes, the sewage contains brewery, tannery, bleachery and dye wastes, but only the dye and gas wastes make trouble, and the latter only when charged with potassium chromate. The gas wastes reduce the quality of the effluent by 30 per cent, according to Walter Scott, chemist of the works.

All the Bury sewage was passed through grit chambers, inclined bar screens, settling tanks and trickling filters before the activated-sludge process was introduced, and part of it still is, including that subjected to activation. The activation tanks are 9 ft. deep. Each alternate agitation wheel works in a direction opposite to the next one. The wheels are driven by shaft and gear, and use from 22 to 25 hp. (for some 0.9 m.g.d.). Excess sludge is pumped to and mixed with crude



GAS ENGINES OPERATED BY GAS FROM SLUDGE-DIGESTION TANKS, SEWAGE-WORKS OF BIRMINGHAM, ENGLAND

A 450-hp. and a 150-hp. installation.

sewage and passes to the settling tanks already mentioned. An old filter bed is now being converted into an additional activation tank, 14½ ft. deep, with settling tanks 22 ft. deep.

London—For decades the Barking and Crossness plants for treating London sewage were among the most notable examples of chemical precipitation to be found in or out of England. In 1904 it was expected that they would be supplemented or else supplanted by some one of the so-called bacterial processes. Time passed without such action; the War put a stop to all municipal construction and to the operation of some existing works as well. The old tanks are now used for plain sedimentation only.

Small working-scale experiments with the activated-sludge process have been carried on by the London County Council for a number of years past, in a plant of perhaps 0.30 m.g.d. capacity. A project is now on foot for a much larger-scale experiment. This is described as follows in a letter from G. W. Humphreys, chief engineer, London County Council:

> Tenders have been outlined for the first section of the work, and it is hoped very shortly to start construction on a 6- to 12-m.g.d. plant, the actual capacity being that which will be found by experiments to give the greatest efficiency. The sewage to be treated will be the effluent from the existing sedimentation channels. This effluent, with a proportion of re-activated sludge, will be passed through 22 aeration channels, each 300 ft. long, constructed at two levels, one set being immediately above the other. The sewage will pass alternately for distances of 100 ft. in an upper and a lower channel. Paddles at each end of each pair of channels will give the necessary propulsion to the sewage, and air diffusers will be placed in the channels at intervals. Two types of settling tanks (Dorr and ordinary pyramidal) are to be provided to test their comparative advantages. Re-aeration is to be carried out in separate tanks by air diffusers. The effluent is to be discharged into the Thames without further treatment. The surplus sludge will be mixed with the sludge from the old sedimentation channels and discharged at sea at the mouth of the Thames. It is not proposed to make any attempt to convert the sludge into a commercial fertilizer, but the council is carrying out experiments on a small scale on sludge digestion.

Exeter—None of the many changes in sewage treatment is more interesting historically than the one at Exeter. It was here that Donald Cameron built the first septic tanks bearing his name. After a quarter-century's use these and the supplementary contact beds, both the prevailing mode in 1904, are giving way to the activated-sludge process, with sea dumping as the probable means of sludge disposal.

Glasgow—Scotland's great port and industrial center, Glasgow, is the largest city in the world which still makes chemical precipitation its main reliance for sewage treatment. Its three chemical precipitation plants treated a combined average total of 117 m.g.d. during the year ended May 31, 1928. Of the three plants, the Dalmarnock was put into use in 1894, the Dalmuir in 1904 and the Shieldhall in 1910. Some of the tank effluent is put through trickling filters and mixed with the flow from the precipitation plants. A little sewage is subjected to the activated-sludge process, various types of which have been tried on a small scale. Through the courtesy of W. S. Tennant, general manager of the Glasgow sewage-works, I visited two of the Glasgow plants.

At the Dalmarnock works the contact beds formerly used have been converted into chemical precipitation tanks, and the sand filters that formerly received some of the contact bed effluent have been made into trickling filters, which receive chemically precipitated sewage. The two effluents are mixed to produce a non-putrescible liquid to go into the River Clyde. The combined flow from the tanks and filters averages 24 m.g.d., which is one-thirteenth the discharge of the stream. The precipitants used are lime and alum.

The normal working rate of the five acres of trickling filters is 9.6 m.g.d., or 40 per cent of the combined flow from the filters and the tanks. For the fiscal year 1927-28 the filters treated 35.6 per cent of the chemically treated sewage. They have been in use for eight years, and are of broken stone, 1½ in. at the top, graded to 6 in. at the bottom, with a total depth of about 8 ft. They have been seeded with *Achorutas viaticus* to prevent colloidal deposits which would cause cracks in the beds and let the sewage pass through without nitrification.

Sludge at this plant, when in demand at a price that will make it worth while, is pressed and sold; the remainder is pumped through 6 miles of 9-in. pipe to the Shieldhall works and, with the sludge from that plant, is barged to sea.

At the Shieldhall works nearly all of the dry-weather flow of 36 m.g.d. is treated by chemical precipitation. The remainder, sometimes up to 0.6 m.g.d., is treated by the activated-sludge process. In 1922-23 activation was produced by Haworth paddlewheels. In 1925 a diffused-air plant was installed with re-activation of the sludge. Subsequently the plant was operated without re-activation at a slightly lower average rate, but in 1929 activation was resumed. It increases the tank capacity. Spiral-flow aeration is used, after twenty minutes of presedimentation. In the plant using Haworth paddles for activation, with a much shorter period of presedimentation, about 0.36 m.g.d. was treated, against up to 0.6 m.g.d. by the diffused-air method. About the same degree of purification was attained in each case. The surplus sludge from the activated-sludge process is bulky for barging to sea.

Salisbury—John Hamlin was still on duty as manager in 1929. In his half-century of service all three of his sons have been trained as sewage-works managers. The father, now 74 years old, looks forward to seeing his youngest son as his successor. Charles Notley, now deputy city surveyor under W. J. Goodwin, was a junior engineer in 1904.

Except for enlargements and improvements, the Salisbury plant is substantially as it was in 1904, after a change from chemical precipitation to septic tanks and trickling filters. In an annexed district there is a sewage farm. The Stoddard distributors on some of the primary filters were abandoned long ago, because of difficulty in keeping the perforated corrugated-iron trays in a level position.

Material removed from the bar screens at the grit chambers, and also the fine, black scrapings from the secondary filters, are used in part for municipal parks and for "allotment plots" (small gardens allotted by the city on application). A contractor pays the city $238 a year for the remainder, under a three-year contract.

The refuse destructor, close by the sewage-works and also under the direction of Mr. Hamlin and his son, supplies heat to boiler furnaces which give all the power required for works purposes. This includes not only electricity for lighting but also compressed air for the Shone ejectors, which now lift the sewage of the entire city, as they did part of it in 1904. Mr. Hamlin believes that the ejector plays a material part in the treatment of the sewage.

Hampton-on-Thames—The Travis hydrolytic or two-

story settling and sludge-digesting tank which was under construction 25 years ago at Hampton was duly completed and is still in use—giving satisfaction, according to S. H. Chambers, who is still town surveyor. This and a very few others—at Durham, Luten and perhaps one or two other places—are the only Travis tanks ever built in England. The Travis "hydrolizers" or upward filters, to which the tank effluent first went at Hampton, have been changed over to sedimentation tanks. Of the triple contact beds, the first and second have been made into percolating filters. Some of the effluent they produce goes to the third set of contact beds and is then used for boiler purposes. The old settling tanks between the original contact beds have been made into percolating filters. Besides the percolating filters already mentioned, new ones have been built, both primary and secondary. Sludge from the Travis hydrolytic tanks goes to trenches and is covered with earth; after about a year it is uncovered and taken away by market gardeners. The other sludge produced at Hampton is treated on drying beds.

Pipe Lines of the Hetch Hetchy Aqueduct

By M. M. O'Shaughnessy
City Engineer, San Francisco, Calif.

THE sections of the Hetch Hetchy aqueduct now completed contain about 23 miles of 60- to 114-in. steel pipe. Nearly 50 miles of additional pipe will be constructed to complete the initial installation. The completed sections were built in the years 1923 to 1925 and were put into service immediately on completion.

Riveted joints are used on the 23 miles already built except for the heavier sections of the Moccasin Power plant penstocks, which have hammer-welded longitudinal and double-riveted bumped circumferential joints.

In the specifications prepared in 1923, 58-in. lock-bar pipe and 58-in. welded pipe were recognized as alternative to 60-in. pipe with longitudinal double-riveted lap joints. Concrete pipe was not considered suited to any part of the job. Single-riveted lap joints were required for circumferential seams in any case. The plate thicknesses are $\frac{5}{16}$, $\frac{3}{8}$ and $\frac{7}{16}$ in. No bids were received on any but riveted pipe, except one very high bid on electrically welded pipe. Riveted pipe won the contract.

At that time no California manufacturer was prepared to bid on other types in competition with riveted pipe. Large concrete pipe was not yet being seriously offered for heads over 50 or 75 ft.

These conditions have all changed, processes have been improved, and reinforced-concrete pipe, including the type having a steel cylinder incased in the concrete, has come into extensive use over a fairly wide range of conditions. It is therefore to be expected that in the bidding on future contracts there will be keen rivalry among the makers of the various types of steel and concrete pipe. Specifications will of course be so drawn as to exclude any particular type from consideration for situations for which its suitability is doubtful.

Two submerged crossings, 2,753 and 402 ft. in length, both in salt water, were built of 42-in. cast-iron pipe. The longer of these reaches a maximum depth of 67 ft. below mean sea level, and the maximum possible unbalanced pressure on either is 172 lb. per sq.in. The pipe is identical in design with that used in the Narrows siphon No. 2 of the New York City system, except that the barrel thickness is 2 in. instead of $1\frac{7}{8}$ in. It is in 12-ft. laying lengths, with flexible joints of the ball-and-socket type. Lead is poured into these joints in the ordinary manner and calked by forcing in additional lead through tapped holes in the bells. The pipe was laid in a dredged trench, generally in clay bottom. To prevent movement when under pressure, due to yielding of adjacent soft or plastic material, a bed of crushed rock was placed in the trench, and the trench was partly backfilled with crushed rock after laying the pipe.

Cast iron is usually chosen instead of steel in such situations on account of its greater resistance to corrosion. It it worthy of note, however, that the submerged lines mentioned are paralleled by four lines of lap-welded steel flexible-jointed pipe, two 16-in., $\frac{5}{16}$ in. thick, laid in 1888, and two 22-in., $\frac{3}{8}$ in. thick, laid in 1900, which as yet give no evidence of deterioration. The bell-and-spigot ends are of cast iron, riveted on. The pipes were galvanized and given an asphaltic coating. They were laid on the bottom without trenching, and are exposed for some distance from shore at low tide. The coating on exposed sections appears to be in good condition, the leakage, if any, is negligible, and the resistance to flow does not appear to have increased materially.

The Hetch Hetchy aqueduct pipes are coated with bituminous enamel. On the greater part of the 5-ft. pipe this was applied by dipping; on the larger pipes and the 42-in. flexible-joint pipe, by hand brushing over a thin priming coat.

Where the completed pipe is left exposed, a coat of aluminum paint over the outside protective coating is desirable, to reduce the heat absorption when the pipe is empty.

Coatings applied at the manufacturing plant or at a central yard are liable to considerable damage in handling and in delivery to the location of the pipe line. In constructing the 5-ft. pipe line the contractor was put to considerable expense for repairing and retouching the coating because of damage due mainly to carelessness of truck drivers in unloading the pipe, and this also put a great deal of extra work on the city inspectors. I have noted the same thing on other jobs. It would certainly save considerable money and annoyance on such work if the contractors would exercise strict control over drivers and others handling the pipe.

Hydrogen Cooling Utilized in Condenser

An order for the first hydrogen-cooled synchronous condenser to be used west of the Mississippi River has been placed by the Southern California Edison Co., of Los Angeles. This condenser, which is rated 15,000 kva., three phase, 11,500 volts, 50 cycles, at 750 r.p.m., will be placed in operation at the company's San Antonio substation. By using hydrogen instead of air as a cooling medium, approximately 20 per cent greater cooling efficiency is obtained. The hydrogen-cooled condenser also has materially lower losses. This type of equipment does not need to be placed within a substation building, inasmuch as it is so constructed as to permit of its use in the open. This particular feature makes this type of condenser very suitable to southern California conditions.

Reinforcing Railroad Bridge Piers Under Heavy Traffic

Work on Lower Maumee River Structure at Toledo Involves Difficult Underpinning Work Using Open Cofferdams in Water 15 to 30 Ft. Deep

TWO abutments and eight piers, including a swing span pier of the lower Maumee River bridge of the Toledo Terminal Railway Co., have been strengthened and widened to carry heavy double-track traffic by methods involving interesting procedure in open cofferdam work. The job was rendered more difficult because it had to be carried on without interrupting railway traffic and because unforeseen conditions, requiring extensive repairs, were encountered on the old piers.

The Toledo Terminal Railway Co. operates a belt line railroad around Toledo, Ohio, affording transfer facilities for the ten major railroads that serve the city. This belt line consists of double trackage, with the exception of two single-track bridges across the Maumee River, one at the lower end of the river and the other some 10 miles upstream. Traffic at the latter is not unduly heavy, but at the lower bridge, a through-truss structure of five fixed spans and one swing span, an average of 80 trains per day has to be accommodated. Inasmuch as these trains are all long and slow freights, the old single-track bridge was greatly overtaxed.

Although the old bridge was a single-track E-40 structure, its piers from the bottom to the water line had been designed and built to accommodate a double-track bridge. However, the required E-70 loading had not been anticipated, and it was quite evident from the beginning that the piers would have to be reinforced. Before letting the contract, however, the railroad company made a careful examination of the old piers. The conditions disclosed were so unusual and gave promise of being so variable that a cost-plus-fixed-sum contract was decided upon.

The old foundations consisted of sandstone piers on timber grillages 4 ft. thick, located from 8 to 23 ft. below river level and resting on wood piles driven to firm bearing. The piles had been cut off at the river bottom and the timber grillages set directly on them, but considerable scour had removed material from beneath the grillages to depths of 5 to 10 ft., leaving the top portions of the piles without lateral support. Also, one of the piers (No. 6, Fig. 1), which carried one end of the swing span, had been shoved upstream by a steamer so that its timber grillage overhung the last pile by about 10 ft. In addition all of the piles in this pier were found to be inclined approximately 10 deg. to the vertical, as shown in Fig. 3.

Construction—Test piles driven nearby were found to support a maximum load of 40 tons. Assuming a design load of 20 tons, all the old piers were found to have insufficient piles to support the new structure. It was therefore necessary to drive extra piles, and since it was advisable not to increase the base area more than absolutely necessary, the piles were confined to a narrow belt around the piers.

FIG. 2—DEWATERED COFFERDAM INCLOSING OLD PIER
Piling being driven to enlarge base of pier.

The open cofferdam method was adopted. The abutments presented no particular problem, a pier type being used, resting on creosoted piles. For the river piers the work involved the construction of six steel arch-web sheet-piling cofferdams varying in depth from 15 ft. to 35 ft. and having outside dimensions of approximately 76x33 ft. The cofferdam bracing, in the form of cribs, was towed into position and blocked against the old piers before the sheet piling was driven. Two 14-in. steam centrifugal pumps, operated by compressed air, were used to dewater the cofferdams. Later the cofferdams were maintained dry by means of small plunger pumps and small electric centrifugals.

An interesting method of utilizing ordinary cinders for calking the cofferdams was developed and involved

FIG. 1—LOWER MAUMEE RIVER RAILWAY BRIDGE, TOLEDO, OHIO, SHOWING PILES ADDED FOR NEW DOUBLE-TRACK STRUCTURE

FIG. 3—RESULT OF STEAMER COLLISION WITH BRIDGE PIER

View taken beneath pier No. 6, showing how supporting piles were pushed from vertical. Note rail reinforcing placed for concrete mat; also permanent steel sheet piling cutoff wall in background.

merely depositing the cinders on top of the water outside the cofferdams. Then as the cofferdams were unwatered the cinders were drawn down and sucked into the loose openings. Later as leaks developed more cinders were applied to those cracks which were visible.

The silt between the piles under the old piers was excavated by hand, after which permanent steel sheet piling was driven around the edges of the area outlining the enlarged piers. Inside of this inclosure the new wooden piles were driven. The clay bottom was very stiff and it was found necessary to drive a few piles at one end and then a few at the other end in order to keep the old piers approximately level. All piling was driven from floating equipment.

With the new piles driven, reinforcing steel consisting of railroad rails as well as bars was placed, and a new concrete mat poured in the dry. This mat filled the spaces between the river bottom and the old wood grillages and in addition incased the grillages on all sides. In order to be sure that the new concrete was tight against the bottom of the grillages, grout pipes were attached on the sides and ends of the piers and allowed to project about 4 ft. above the top of the grillages. After all concrete was poured grout was forced through these pipes at 90-lb. pressure. All concrete was mixed at central mixing plants on either end of the bridge and transported to the piers over a narrow-gage track suspended on the outside of the bridge trusses.

FIG. 4—WIDENING PIERS OF MAUMEE RIVER BRIDGE

View shows work incident to adding new copings. Note industrial railway track outside of bridge trusses on which concrete was transported from land mixing plants.

The repair of the piers also required cutting off about 4 ft. from the tops and replacing this with reinforced-concrete copings, the tops of which were 2 ft. below the original pier coping in order to accommodate deeper trusses on the new superstructure. The new copings were built by cutting away all of the old coping except a small pedestal for the present bridge bearing and constructing a new coping over the removed portion. After this concrete had set sufficiently the load of the bridge was carried to it by shoring beams, permitting the pedestals to be removed and the new coping completed.

Pier No. 5, supporting the swing span, presented a more difficult problem, since river traffic could not be interfered with. However, work on this pier was not undertaken until river traffic was closed down for the winter, and then the method used was in general a repetition of that used on the other piers.

In the six piers and two abutments 5,000 cu.yd. of concrete was placed. The concrete was designed utilizing the water-cement ratio theory. The proportions were 1:2.7:3.6, and cylinders tested after six months had a strength of 5,100 lb. per square inch. It was claimed by the engineer in charge that 1,000 bbl. of cement was saved by taking advantage of the water-cement ratio method of mix design and that this was accomplished in spite of the fact that one-half to one bag of extra cement was used when water was encountered.

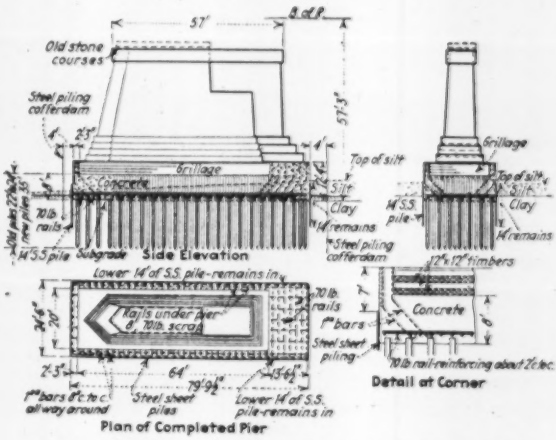


FIG. 5—PIER NO. 6, TYPICAL OF OTHER PIERS

Special care was taken in ordering the steel sheet piling so that a minimum amount of it would need to be purchased. Thus enough piling was ordered for pier No. 7, for one of the short piers and for the center pier. The 50-ft. piling ordered for pier No. 7 was used on piers Nos. 6 and 7, and then cut in two and used as cutoff walls on the swing pier. Also most of the cofferdam sheeting on other piers could be used for cutoff sheeting, so that at the end of the job the only second-hand sheeting to be sold was that in the cofferdam of the last pier completed.

F. J. Bishop, bridge engineer of the Toledo Terminal Railroad Co., was in charge of the design and supervised the construction for the railroad company, with H. Ibsen, consulting engineer, Michigan Central Railroad Co., as consulting engineer. The Foundation Company was the general contractor and the work was handled by its Pittsburgh office.

Marking Traffic Lanes on California Pavements

Striping Machines Operated at ¾c. Per Foot—State Highway Plans 3,500 "Stripe Miles" Annually for Next Biennium—Paint Specifications

BOULEVARD STRIPING IN SAN FRANCISCO
The intent is to have the two center lanes used for passing only; stripes tend to make drivers keep in the proper lanes.

MARKING traffic lanes on highway and boulevards has been standard practice in California since 1926, and the plan is rated as a decidedly worth-while safety measure. A stripe serves as a constant reminder to a driver to keep on that part of the road where he belongs, whether he is driving on a narrow mountain road or on a city boulevard where four or more lanes of traffic travel abreast. Highway driving at night or in foggy weather is made so much safer by the traffic lines that all traffic is speeded up without increased hazard. For these reasons pavement striping is regarded as a permanent feature of California highway construction and maintenance.

Although costs have not changed materially since previous articles on this subject (*Engineering News-Record*, April 26, 1928, p. 671, and April 25, 1929, p. 686), methods and specifications have been changed somewhat. The state highway system now uses white lines, while San Francisco, which has an extensive boulevard striping program under way, uses more yellow than white or any other color. Features of both city and state highway practice in striping as now in vogue are outlined in the following.

Pavement Striping in San Francisco

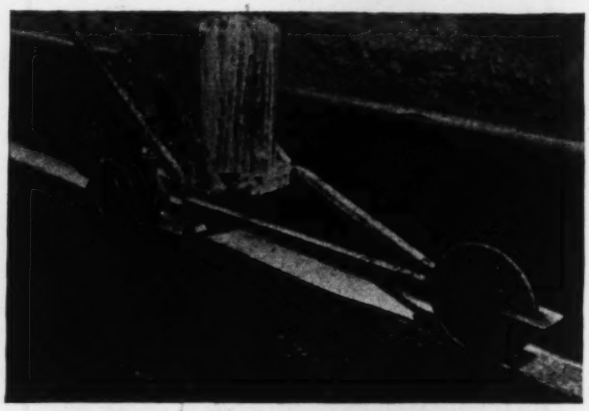
By George D. Burr
City Traffic Engineer,
San Francisco City Engineer's Office

DURING 1929 San Francisco placed approximately 35 miles of pavement stripes, exclusive of curb markings. In 1930 about 60 miles of striping will be put down. The city has selected as most economical a painting machine employing an air-spray method of application. With this equipment the cost of the lines varies between ¾c. and 2c. per foot, depending upon the amount of cleaning or preparatory work on the pavement that is necessary, the amount of striping done in a given location and the current wage scale. No material difference has been found in the cost of placing 3-in. and 6-in. stripes, as labor is the principal item. The standard width is 4 in.; 6 in. is used on center lines, and some heavily traveled boulevards have 8-in. striping.

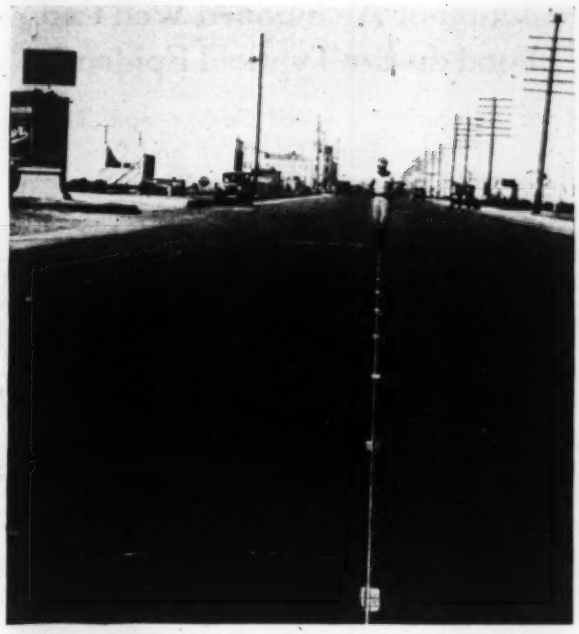
Specifications for paint which the city will accept for this work call for a yellow lacquer that will dry dustproof within five minutes and will dry hard within 45 minutes. Chemical analysis must show approximately the following content:

	Per Cent
Pigment	30
Plasticiser	2½
Nitrocellulose and gum	27½
Solvent and thinner	40

In addition to these requirements practical tests are required on five counts—namely, (1) the paint must retain its yellow color for one year under field conditions, (2) it must have approximately the same apparent color when wet as when dry, and when seen by artificial light as it has in daylight; (3) it must adhere to more or less dirty asphalt, concrete or granite, as well as to newly paved surfaces; (4) it must brush out easily and



STRIPING MACHINE READY FOR OPERATION
Long leverage on the guide wheel makes for smoother alignment.



PLACING MARKS FOR A NEW STRIPE
A ½-in. rope is stretched between established points and paint marks are made at intervals.

smoothly, and (5) it must have good wearing qualities.

Red is used to mark "no stopping" zones on curbs; yellow is used in striping throughout the business district and wherever traffic is heavy on asphalt-paved surfaces, and white is used on boulevards and in outlying districts. A preference for yellow downtown results from the observation that where wear is heaviest a yellow stripe, after being partly obliterated by pedestrian traffic, leaves a more clearly defined mark than does the white. On the other hand, in outlying districts where long-range visibility of the lines becomes a factor and where the wear is largely vehicular, white is preferred.

For intersections where particularly complicated traffic movements occur, a painting plan is prepared in the office before the field work is done. Such a plan for the Great Highway is reproduced in the accompanying drawing. This highway on busy days is now being traversed by about 5,000 vehicles per hour and the rate has been increasing steadily. Trucks are not allowed on this boulevard, but are required to use the lower road just inshore, which also handles local traffic paralleling the boulevard. For the 2-mile length there are no cross-connections between the upper and the lower road.

Traffic Stripes on California Highways

By T. H. Dennis
Maintenance Engineer, California Division of Highways

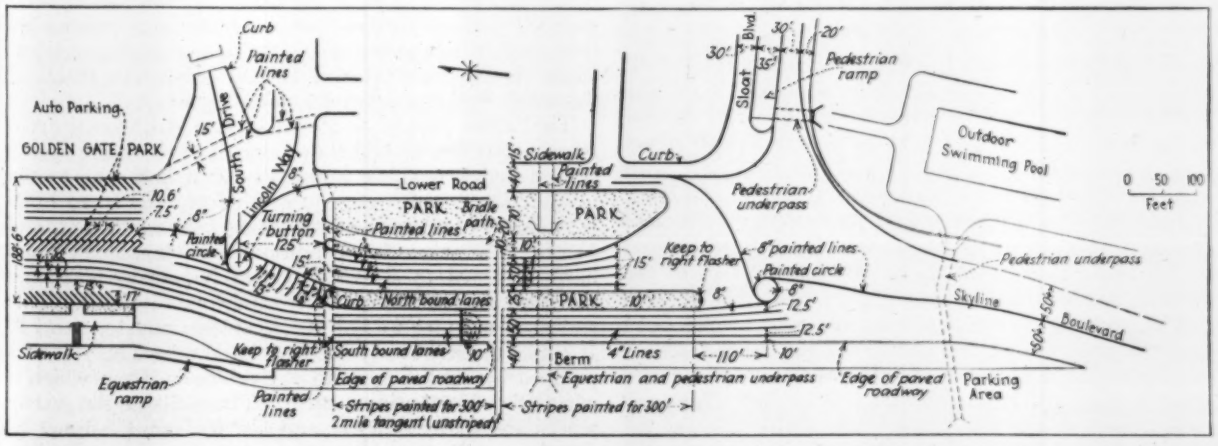
THE first statewide program of pavement striping on California highways was initiated in 1926, and by the end of 1927 some 300 miles of traffic line had been placed on curves and on the most heavily traveled routes. Since then the amount of striping has increased year by year; 1,800 miles of highways were striped during 1929 and the same amount will be put down this year. For the next biennium, estimates have been prepared to provide for striping 2,200 miles of pavement, or the equivalent of 3,500 stripe-miles per annum.

When striping was initiated the practice was to use a line 6 in. wide, and experiments were made with white paints as well as with orange and yellow colors. The present standard is a 4-in. width and exclusive use of white traffic lacquer. The white, it was decided, has the best visibility at night and when the line is worn. Traffic lanes 10 ft. wide are standard, although 18-ft. pavements also are striped.

On the narrower pavements stripes are placed only on narrow bridges, on curves and at other danger points. Stripes are now placed along the pavement edges in territory where fog is frequent and also where the edge is not well defined, as on loose oiled shoulders where the similarity in color otherwise prevents the driver from determining the limit of the pavement, particularly at night.

When a new stripe is put on, care is taken to mark out the lines ahead of the painting to insure true alignment. All irregularities in the line are greatly magnified to the critical eye and the extra expense for advance measurements and marking is well worth while.

Seven crews are now assigned to striping on the state highway system. Each crew includes three men, a paint machine operator, a truck driver and a helper, the latter placing and taking up flags used for protecting the fresh paint and also assisting in mixing the lacquer. The attendant truck provides transportation for men and supplies and usually moves either just ahead of or just



STRIPING LAYOUT ON THE "GREAT HIGHWAY" ALONG THE OCEAN BEACH

behind the paint machine, as protection against traffic. Lacquer is delivered to the job in 5-gal. cans and is mixed with thinner in the tank of the spray machine, which holds 8 gal., the proportion usually being about 0.3 gal. of thinner to 1 gal. of lacquer. The painting machine carries a small gasoline compressor which provides the 15 to 20 lb. per sq.in. pressure used in spraying the paint. One man pushes the machine by using handles similar to plow handles and his assistant places flags on the freshly painted line at intervals of about 100 ft.

When a tank of lacquer is exhausted, the operator and helper mix a new batch and the truck is sent back to pick up the flags. Despite the quick-drying quality of the paint and the line of flags, it is difficult to keep autos off the newly painted line, and aid from the local traffic officers is usually necessary to prevent tracking up the pavement. Because it has been found impossible to secure a good line with one wheel of the machine on an unpaved shoulder, marking along the edge of a pavement is done with an offset which permits the machine to ride entirely on the pavement.

For the past two years commercial traffic lacquer has been used in place of the paint made up according to state specifications that was previously required. Before paint purchases are made, samples are submitted by the venders and laboratory tests are made as a comparison with paint previously found satisfactory.

Where a uniform pavement edge is exposed or where longitudinal joints are convenient, the striping machine may be kept in alignment, as it moves along, by an outrigger attachment or by following a center line joint. More often it is necessary actually to mark out the line in advance. This is done with a 300-ft. length of ½-in. rope placed in the desired location by measuring from the edge of the pavement and then spot marked with paint at intervals of 2 or 3 ft. If the spot marks are too far apart, the operator has difficulty in keeping his alignment smooth.

About 12 gal. of lacquer and 3.6 gal. of thinner are required per mile of 4-in. stripe. In 1929 the total cost for this work was about $40 per stripe-mile. The most durable stripes are those put on in the fall. In general, a line is painted only once a year, although where traffic is heavy or conditions especially dangerous, the lines are renewed every six or eight months.

English Railway Bridge Raised by Jacks

Subsidence due to underground mining operations recently made it necessary to raise a section of track 3 ft. in elevation on the Monmouthshire section of the Great Western Railway in England. Included in this section was a steel bridge weighing 30 tons. The bridge structure consisted of wrought-iron main cross-girders with a curved plate floor. In order to raise this, the track was disconnected at each end of the bridge, steel brackets were fastened to the ends of the main girders, and six hydraulic jacks were placed between the tops of the abutments and the brackets. The entire bridge was then brought up to the new level and held by the jacks until the masonry of the abutments had been raised a corresponding amount. While this work was going forward the approach tracks on each side of the bridge were being raised to the new grade. The entire job was accomplished in a little less than 24 hours.

Pollution of Abandoned Well Causes Fond du Lac Typhoid Epidemic

River Relocation Allowed Sewage and Tannery Waste to Enter Old Well and Pass Underground to City Wells

AN epidemic of gastro-intestinal disorders which broke out during last October in the city of Fond du Lac, Wis., was recorded in *Engineering News-Record*, Oct. 31, 1929, p. 703. More than 1,000 cases of dysentery among a total population of 28,000 were followed by 50 cases of typhoid, with three deaths. According to a report by L. F. Warrick, state sanitary engineer, and E. J. Tully, chemical engineer, the outbreak was caused by the pollution of the well-water supply of the city through an underground connection, in a creviced limestone formation, with an abandoned private well

NEW CHANNEL OF FOND DU LAC RIVER
Abandoned well responsible for typhoid epidemic was located in this channel.

into which highly polluted water was caused to flow by the relocation of the Fond du Lac River.

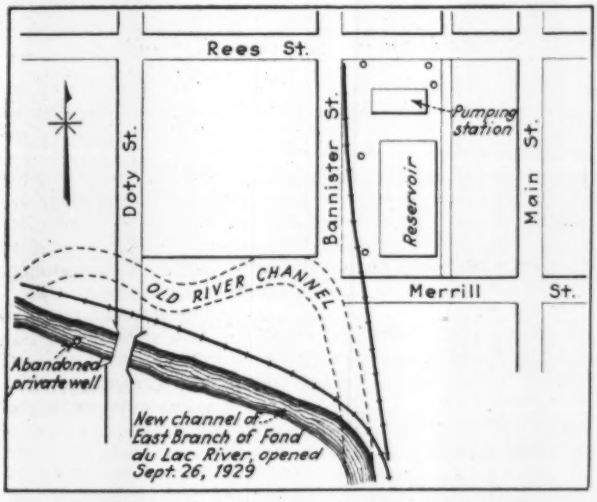
The outbreak began Sept. 28, 1929, with the occurrence of several hundred cases of dysentery, and the number of cases increased alarmingly during the next few days. On Oct. 1, 704 cases were reported in the schools, and there were hundreds of adult cases scattered throughout the city. The condition became so serious on Oct. 2 that the state board of health was notified and an investigation was started immediately. An examination of the characteristics of the epidemic led to the conclusion that the only epidemiological factor which was common to all the cases was the public water supply. The conclusion that the water was responsible was further strengthened by the fact that water taken from the tap gave positive B. coli indications in all of the usual five 10-c.c. fermentation tests.

The water supply of Fond du Lac is obtained from seven wells, five of which are located at the water-works station and two about a quarter- or a half-mile to the north. These wells range in depth from 480 ft. to 1,000 ft. and are cased to depths ranging between 106 ft. and 115 ft. The subsurface conditions are: clay, blue till and hardpan down to a depth of 106 ft.; Galena-Trenton limestone to 296 ft.; St. Peter sandstone to 450 ft.; shale and marl mixture to 525 ft.; Potsdam sandstone to 740 ft.; and quartzite and slate to 1,100 ft. The water is pumped by air lift to a storage reservoir, from which it enters the distribution system. The wells at the water-works are between 200 ft. and 600 ft. from the Fond du Lac River, which receives the waste from a nearby tan-

nery, and the discharge from two small sewers. Both the wells and the reservoir are adequately protected against surface pollution.

Consideration was first given to the possibility of contamination of the water in the distribution system through the many cross-connections in existence in industrial plants between the well supply and river water. However, nothing was found in any of the plants which would indicate that there was any relation between the outbreak and these cross-connections.

When an inspection was made of the wells themselves, it was found that the discharge of several at the water-works station had a slight amount of odor, and the odor of one well in particular was very pronounced. Accordingly, the five wells at this point were closed down immediately and temporarily the city drew its supply from the two others. Bacterial analyses of the water



RELOCATION OF EAST BRANCH OF FOND DU LAC RIVER IN THE VICINITY OF CITY WATER-WORKS

from the five wells closed down confirmed the suspicion that the wells themselves were polluted. Chlorinating equipment was installed on Oct. 4, and the wells were again placed in service.

In the meantime it was brought to the attention of the investigators that on Sept. 26 a new channel for the river had been opened near the tannery and approximately 800 ft. from the wells. Attention was immediately directed to this new river channel, because the investigators were informed that an old well existed somewhere in the new river channel.

With the assistance of the original property owners, the old well was located in the channel about a block west of the water-works. A cofferdam was immediately constructed around the point where the well was found, and a metal cylinder 4 ft. in diameter by 6 ft. high was driven into the ground around it. While the cylinder was being placed in position it was noted that the water level within it dropped several inches. Dewatering of the cofferdam revealed the old well-casing, which had been torn by a steam shovel.

A half-ton of salt was placed in the iron cylinder surrounding the casing and dissolved with water from a hose. Another half-ton was applied about six hours later, and chloride tests were made on the five city wells at various periods during the next four days. The chloride content of one well before the application of the salt was 60 parts per million. In less than seventeen hours after the first application, this concentration had increased to 126, and at the end of eighteen hours had increased to 263 parts per million. Another well gave an equally positive indication. The evidence was conclusive that there was an underground connection between the abandoned well and the wells of the water-works station, and that pollution was entering the supply by that means.

After chloride of lime had been used to sterilize the casing of the old well, compressed air was applied under 80-lb. pressure to ascertain if there were any seams in the bed of the new river channel, and whether there were any connections between this old well and some of the other abandoned wells in the vicinity. Air was found discharging from one old well located some 300 ft. from the river channel and approximately 900 ft. from the city wells. No evidence of seams in the channel was discovered.

To seal the well in the river a small amount of crushed rock was thrown into the casing and it was then filled to the top with concrete. Around the top of the well a concrete collar was constructed extending down about 3 ft. More concrete was poured into the excavation around the well up to a point 2½ ft. above the top of the well. Clay was then placed over all of the concrete.

Efforts are now being made to locate any other abandoned wells in the general vicinity of the water-works station and to fill and cap them when found. Private wells in the neighborhood are to be inspected frequently and tested by the city officials and if found to be in an unsatisfactory or unprotected condition at any time are to be treated with chlorinated lime, filled with concrete, and capped.

The reservoir was thoroughly cleaned and disinfected and the water mains thoroughly flushed. All city water is now carefully chlorinated. A steady but gradual improvement in the quality of the water discharge by the wells was noted from the date on which the old well was capped.

Letters to the Editor

Durability of Portland Cement

Sir—As Dalton G. Miller has shown, the variation in the behavior of cements complying with standard A.S.T.M. specifications is very great when they are exposed to sulphate waters. Mr. Miller has shown that, by steam curing at 212 deg. F., all of these widely variable cements may be rendered absolutely immune to the action of sulphate waters. It would seem that standard A.S.T.M. specifications are not a true criterion of the behavior of portland cement exposed to sulphate waters.

It would also appear that Mr. Merriman, in his article "Durability of Portland Cement" in your issue of Jan. 9, presents a test that is a very fair measure of the resistance of portland cements to sodium sulphate solutions. That is what the test appears to be, and it was by immersing the samples in a 10 per cent sodium sulphate solution that the validity of the test was established.

As for "completeness of manufacture," "outdoor exposure—to sunshine, rain, heat and in all these many combinations and effects," "ability to resist disintegration . . . under outdoor exposure," "index of disintegration," etc., the writer feels that the connection between these things and the sodium sulphate solutions has not been conclusively established. Neither has any consideration been given in Mr. Merriman's article to construction methods, excess mixing water, segregation, incomplete curing, or, in other words, nothing has been said about the degree of "completeness of manufacture"

of the concrete, which surely contributes to its subsequent weal and woe. With disintegration as intimately and significantly connected with construction joints as it is in the vast majority of cases, what we appear to need most is not so much a phenolphthalein or methyl orange test for cements as it is a phenolphthalein or some other test for construction joints.

W. F. WAY,
Contractor and Engineer.

Seattle, Wash.,
Jan. 29, 1930.

Tests of Concrete

Sir—Referring to the letter by Zara Witkin, chief engineer, Herbert M. Baruch Corporation, which appeared in *Engineering News-Record* Feb. 13, p. 295, in "Letters to the Editor" department, in which he takes issue with my article in the issue of Nov. 28, 1929, "A Substitute for the Compression Test of Concrete":

Mr. Witkin cites a number of items for possible errors in the operation. Surely these are avoidable and unlikely, as proved repeatedly by tests, where tests are conscientiously made, as any test should be made to be worth anything.

As to the number of separate operations, may I say that the test consists of about ten simple operations. The fact that the method is so simple as well as reliable makes it very attractive.

I believe this method for unscrambling plastic concrete which I have developed and described in the article referred to is a useful, reliable and quick way—a short cut—to determine immediately the actual quality of the concrete as produced from day to day. It is a good criterion of the quality of the concrete actually going into the work which gives a close forecast of the strength of the concrete being poured, without waiting for compression tests, and is therefore valuable both to the contractor responsible for the concrete and to the owner.

In closing let me say that I am none the less thankful to Mr. Witkin for his published letter, because it may attract further attention and constructive criticism and improvement of this method by those who strive seriously for better field control in the art of concrete making.

GEORGE J. GRIESENAUER,
Cement Tester,
C., M., St. P. & P. R.R. Co.

Chicago, Ill.,
Feb. 22, 1930.

Infiltration in Sewers

Sir—My specifications for sanitary sewers for the city of Austin, Tex., contained a clause limiting the amount of leakage to 20,000 gal. per mile of sewer per day, and prescribing a method of measuring such leakage. This test is made immediately after the sewer is constructed, by filling the sewer with water and measuring the amount that has to be added to keep the sewer filled. I should like to know if such leakage specifications and tests are generally used in other sections of the country. I know that they are not used in Texas. Also, if used, what is the allowable amount of leakage and how is this leakage determined?

H. R. F. HELLAND,
Of Hawley & Freese,
Consulting Engineers.

San Antonia, Tex.,
Feb. 3, 1930.

There is little published information on this subject. Record of infiltration of water into sewers in several cities was given in *Engineering News-Record* of April 1, 1926, p. 528. From a paper on the new sewer system at Springfield, Ill., by W. B. Walraven and S. A. Greeley, in the 1927 *Proceedings* of the Illinois Society of Engineers, it appears that conditions in individual sewers ranged as follows: 2,700 gal. per mile per day in 36- and 39-in. segmental block sewer; 3,200 in 66- and 69-in. concrete sewer; 10,900 in 27-in. concrete pipe; 15,000 in 33- and 36-in. concrete pipe, and 42,000 in 66-in. monolithic concrete sewer before pointing or patching.

As to specifications, practice differs considerably. Of two Chicago consulting engineers, one does not include in his specifications any specific allowances for leakage or infiltration, as the quantities vary considerably. But the quantity is measured frequently as the work progresses in order to guide the engineer and the contractor as to the quality of work required. The other engineer does specify allowable leakage and test for infiltration, limiting the amount to 5,000 gal. per mile per day in sanitary sewers and in combined sewers of less than 30-in. diameter. After the backfilling and after a protracted rainy season, tests are made by installing weirs in the manholes and gaging the flow. This engineer is of the opinion that much more infiltration is caused by structural weakness of the sewer than by bad joints.

In the 1928 report of the Metropolitan Drainage Commission of Minneapolis and St. Paul it is pointed out that the quantity of groundwater infiltration varies greatly, "depending upon the size and depth of the sewers, the tightness of the joints, the workmanship and material used in construction, the age of the sewer, and particularly the character of the soil and the elevation of groundwater with respect to the surface." Tables for the two cities give this infiltration in specific sewers (size and material not stated) as 25 to 3,100 gal. per acre per day. In Chicago, with the combined system of sewerage, no attempt is made to prevent ordinary infiltration and no tests for tightness have been developed.—EDITOR.

Safe Dam for San Gabriel Canyon

Sir—In *Engineering News-Record* of Jan. 23, 1930, p. 166, in your news item entitled "Status of San Gabriel Flood Control" you seem to assume that the greatest height to which a dam at the "forks site" may safely and conservatively be constructed is 300 ft. If this be so, it must result from some damage to the dam site from the extensive blasting done in an effort to prepare the site for a concrete dam, on which the county flood-control district is said to have expended more than a million dollars in a vain attempt to find a suitable foundation for such a dam.

In the years 1896 and 1897 the writer devoted much of his time to examining and exploring dam sites in the San Gabriel Canyon, in connection with another civil and hydraulic engineer and an internationally known geologist. The purpose was to store water for the development of hydro-electric power in one or more reservoir sites of sufficient capacity to regulate the flow of the San Gabriel River.

As a result of these investigations the unanimous conclusion of all three was that a high dam of elastic or flexible type could be constructed at the "forks site," but that any rigid dam of concrete or masonry would be unsafe because of the nature of the foundation. No limit was placed on the height, except as it would be governed by the height of the hillsides and the cost involved in relation to the benefits to be obtained. The question of a dam from 400 to 450 ft. high was thoroughly considered and agreed to be safe for the site, if constructed of earth, rockfill or a combination of the two, provided it be designed along conservative lines and with all necessary safeguards.

The writer was still of the same opinion when the site was adopted by the flood-control district, and so reported to the Harbor District Chambers of Commerce of Los Angeles County when asked for an opinion. However, the district adopted a plan for a concrete dam, for which the state engineer refused to grant a permit, after the district had expended some three million dollars on that project.

Work on the proposed rigid concrete dam was suspended only after the state engineer's board of experts, consisting of Messrs. Berkley, Elliott, Hinderlider, Louderback, Savage and Williams, had condemned the site for a concrete dam and stated that it is only safe for an elastic structure, which report was rendered in November, 1929. As a result of the findings of this board, the writer was presented with an engrossed resolution from the Harbor District Chambers of Commerce in commendation of the position he had heretofore taken in relation to the matter. The writer is still of the opinion that a dam over 400 ft. high may be constructed, if designed of a suitable type for the site, unless some change in the condition of the abutting hillsides has been brought about by artificial means, such as excessive blasting.

F. C. FINKLE,
Consulting Engineer.

Los Angeles, Calif.,
Jan. 31, 1930.

News of the Week

South Carolina Bond Ruling Refused by Supreme Court

An appeal to the U. S. Supreme Court by certain citizens of South Carolina seeking to prevent a $65,000,000 state highway bond issue was dismissed by that body on March 3, on the ground that the case did not present a substantial federal question. This means that the South Carolina Supreme Court has supreme jurisdiction on the question. As this court has already affirmed the validity of the bond issue (*Engineering News-Record*, Oct. 17, 1929, p. 631), the way is now clear for immediate marketing of the bonds.

A state-wide construction program involving a total of $70,000,000 has already been inaugurated, being financed by money advanced to the state by the counties. The proceeds of this bond issue will be used to repay the counties and to complete the program.

San Francisco to Vote on Buying Electrical Distribution System

On Aug. 26, the date of the primary election in California, San Francisco voters will vote on a bond issue to acquire the local distribution systems of the Pacific Gas & Electric Co. and the Great Western Power Co., to be used to distribute the power developed by the Moccasin plant of the Hetch Hetchy municipal project.

State Court Upholds 5c. Fare in New York City

In the first ruling of a New York state court directly on the binding force of the 5c. fare clause in the contracts between that city and the Interborough Rapid Transit Co., Supreme Court Justice Phœnix Ingraham on Feb. 28 ruled that the 5c. fare on both subway and elevated lines is fixed by contract beyond the power of the transit commission to regulate and that the city is entitled to an injunction preventing the company from increasing the fare. A temporary injunction to this effect has already been issued.

The court's opinion based the inviolability of the fare contracts upon the rapid transit act of 1891 and its subsequent amendments. These, it is stated, show clearly the intent of the legislature to permit the city, acting through the transit commission, to fix a contractual fare which could not be altered by regulatory bodies. Furthermore, it is held, the fact that this contract may subsequently have proved unprofitable for one party is not sufficient ground to relieve that party from its duty of performance. An appeal will probably be taken to a higher court.

Spring Valley Water System Taken Over by City of San Francisco

Fulfills Long Demand for Municipal Ownership—Company Employees Continued in City Service

ON MARCH 3 the city of San Francisco took possession of the properties of the Spring Valley Water Co. through the payment of $41,000,000, including interest and redemption charges. The transfer was made under an ordinance passed by the board of supervisors which created a municipal water department with the control of management and operation vested in the board of public works and the control of expenditures in the board of supervisors (city council). Nelson A. Eckart, who has been chief assistant engineer of the city under M. M. O'Shaughnessy, city engineer, has been appointed general manager of the water department at an annual salary of $15,000.

Other important features of the ordinance creating the water department are: the water budget will be made up by the board of public works on the recommendation of the general manager subject to the approval of the supervisors; all supplies, except emergency equipment, will be purchased by the bureau of supplies; a minimum depreciation fund and water expense reserve of $564,000 is to be set up annually from revenues; water rates are to remain as at present for a limited period; 450 operating employees of the Spring Valley company will be transferred to the city's civil service lists and will be paid the wage scale of the board of public works for similar duties. They will be classified under city rules later. Plans are being made for an appropriate celebration of the city's acquisition of the water system to be held in the Civic Auditorium March 9.

The taking over of the Spring Valley properties marks the termination of the city's effort to secure a system for the distribution of Hetch Hetchy water and a movement for municipal ownership of water-works that has continued for over half a century. Of five bond elections held, the first four—in 1910, 1915, 1921 and 1927—failed of the necessary two-thirds majority, although actual majorities in favor of purchase were registered at each election. Finally, on May 1, 1928, when it was imperative to secure more money to complete the Hetch Hetchy system, the two issues were combined, and after a strenuous campaign a $65,000,000 bond issue was voted for the two purposes. Of this amount $24,000,000 was to be used to complete the Hetch Hetchy system and $41,000,000 to purchase the properties of the Spring Valley company, that sum including the price previously agreed upon.

Following the voting of the bonds, about a year and a half elapsed before the $41,000,000 issue could be sold because of unfavorable conditions in the bond market. The city charter prohibited sale of the bonds under par, and the low interest rate they bore found no market available. On Dec. 16, 1929, the supervisors accepted an offer from a local bank for immediate purchase of the bonds at par and a re-deposit of the money by the city in the bank until March 3, when the city withdrew the amount for payment to the company.

SEATTLE SOLVES THE PARKING PROBLEM

Roofs instead of streets are being used for the storage of automobiles in Seattle, Wash. The city authorities are encouraging this movement and expect to have many such roof garages within a few years. The idea might profitably be transferred to other cities where congestion is acute.

Hydro-Electric Project Planned in Northwest

Plans for a $6,000,000 hydro-electric power development have been revealed by an application filed recently with the Washington state hydraulics office in Olympia for appropriation of 3,500 sec.-ft. of water from the Sauk River, Skagit County, and for use of Sauk Lake as a reservoir, by the Pacific Development Company, of Olympia. Lars Langloe, Olympia hydraulics engineer, is president of the company, and R. K. Tiffany, former state hydraulics supervisor, is consulting engineer. A concrete dam 220 ft. high and 1,200 ft. long is to impound 380,000 acre-ft. of water in Sauk Lake reservoir, while a fall of 185 ft. is to be used in developing 73,580 theoretical horsepower of electric energy.

Moffat Tunnel Bondholders Form Protective Committee

Holders of the supplemental bonds of the Moffat Improvement District, the validity of which is being challenged by court action, have formed a protective committee for the protection of their interests. The supplemental bonds are being attacked by the Denver Land Co. in the Denver District Court, to which the case has been remanded by the Colorado Supreme Court with instructions to include bondholders as defendants.

Seattle Bridge Franchise Granted

Franchises to construct and operate a toll bridge across Lake Washington from Seward Park to Mercer Island have been granted both by the city council of Seattle, Wash., and the Board of King County Commissioners to the Seattle Toll Bridge Co. of Delaware. Final plans and specifications will be presented to the War Department for approval. The remaining step in connection with the western terminal of the bridge will involve arranging for the approach to the structure in Seward Park. The bridge company proposes to begin construction as soon as all franchise and permit matters have been adjusted.

Dean Pegram, of Columbia, Resigns

George B. Pegram, dean of the school of engineering of Columbia University, has resigned from this post to devote his entire time to advanced teaching and research. He was graduated from Trinity College, N. C., in 1895, went to Columbia in 1901, and was appointed dean in 1918. The resignation will become effective July 1.

Dean Pegram will be succeeded by Prof. George W. Barker, now head of the department of electrical engineering of Lehigh University. Professor Barker is a graduate of the Massachusetts Institute of Technology, and has been at Lehigh for only a year. He served in the Coast Artillery Corps of the U. S. Army from 1916 to 1925, attaining the rank of major. From 1916 to 1917 he was in command of troops in France. After several months of service as a member of the War Damage Board Commission, he was appointed adjutant-general of the District of Paris in 1919, and shortly thereafter officer in charge of civil affairs for the American forces in Germany. Since his return from Europe Professor Barker has been artillery engineer in charge of power plants and signal installation in Boston harbor, and also associate professor of electrical engineering at the Massachusetts Institute of Technology.

Cable Spinning Completed on Mid-Hudson Suspension Bridge

The last wire was laid in place on March 3 in the 16¾-in. cables of the Mid-Hudson highway suspension bridge being built by the State of New York at Poughkeepsie. Spinning of the cables commenced Dec. 2, 1929, with the laying of the first wire in the south cable. This cable was completed Feb. 24. Work on the north cable began Dec. 9. Compacting the south cable started March 3, four squeezing machines being used, one descending each way from each of the main towers.

The bridge has a center span of 1,500 ft. and suspended side spans of 750 ft. each. The two main towers rise to a height of 350 ft. above the river. The two cables are made up of nineteen strands of 320 wires. Present plans call for opening the structure to traffic late next summer, probably on or before Labor Day. Tolls will be charged by the state until the bridge is paid for. Modjeski & Moran are consulting engineers on the project, and the American Bridge Co. is contractor on the cables and superstructure.

COMPACTING THE CABLES OF MID-HUDSON BRIDGE

Dallas to Extend Sewage System

Preliminary studies are in progress for the enlargement of the sewerage and sewage-treatment facilities of the city of Dallas, Tex. At present the city's population of about 250,000 is served by a system of separate sewers and a treatment plant consisting of settling tanks only. The existing sewers have been occasioning considerable maintenance trouble for some time, and means for relieving the overloaded system are being considered. Extensions of the sewage plant will be necessary in order to improve the character of the effluent and prevent further pollution of Trinity River. In addition to these problems, a comprehensive master plan for the sewage and drainage of the city is to be laid out so as to enable the outlying sections to proceed with their drainage plans in such a manner as will conform to the general scheme. It is estimated that a total expenditure of $7,000,000 will be necessary to carry out the project, and the voters of the city are to pass upon an initial bond issue of $4,000,000 on April 1. Pearse, Greeley & Hansen, of Chicago, have been retained as consulting engineers.

Demolition Accidents Subject of Conference

Accident problems in the field of building demolition are to be considered at a conference called by the New York State Industrial Council in New York City on March 10. Representatives of the New York Building Congress and of employers engaged in demolition work have been invited to attend, as well as the sub-committee of the State Labor Department dealing with demolition in the new building code, now in the course of preparation, and the building committee of the city of New York.

Activated-Sludge Sewage-Works Advised for Columbus

The city council of Columbus, Ohio, at a public hearing on Feb. 28, went on record in favor of building an entirely new sewage-works not less than 3½ miles below the present works on the Scioto River. The hearing was on a report by R. H. Simpson, chief engineer of the city, transmitting a report by Robert A. Alton, sewage-disposal engineer, and John H. Gregory, consulting engineer, Baltimore, Md., recommending one of two projects: reconditioning the existing works and supplementing them by an activated-sludge plant, or going farther down the river and building an activated-sludge plant, the relative first costs to provide the same total capacity being $4,000,000 and $6,100,000.

The basis of design in either case is a population of 485,000 in 1945, a daily sewage flow of 60,000,000 gal. (60 m.g.d.) and works capable of treating

twice the dry-weather flow. The works should be capable of expansion to meet estimated conditions of 1960, not stated in the report. They should be designed to reduce the oxygen demand and remove suspended solids so as to prevent a nuisance in the Scioto River, which has a low dry-season flow. At the present site no additional land would be required, but for a downstream site land would have to be bought and also a right-of-way for the force main acquired.

Annual costs for the two projects, including maintenance, operation and fixed charges, are estimated at $524,000, or $1.39 per capita, in 1935, diminishing to $481,000, or $0.99 per capita, in 1945 for the present site. For the new site the corresponding figures are $739,000, or $1.95, in 1935 and $658,700, or $1.36, in 1945.

The city already has under construction intercepting sewers to divert sewage from Alum Creek, the Scioto and the Olentangy rivers, in accordance with an order of the state department of health. It is also under a like order to stop a nuisance caused by the existing sewage-works, which are overloaded.

Los Angeles Votes April 29 on $38,800,000 Water Bonds

Development of the water resources of Los Angeles, Calif., by the issuance of bonds to the amount of $38,800,000 will be voted upon at a special election to be held April 29, according to a decision of the city council. Proceeds of the bond issue would be used for the following purposes: purchase of Mono and Owens river watershed lands and water rights, including Mono basin, Long Valley, Round Valley and Owens Valley town and ranch properties, $17,181,000; water development expense, including diversion from Mono and necessary added facilities for pumping in Owens Valley, $10,300,000; enlargement of the present aqueduct, $600,000; additional local storage capacity, $7,500,000; new distribution facilities, $3,219,000.

Gold Medals Awarded to Three Philadelphia Engineers

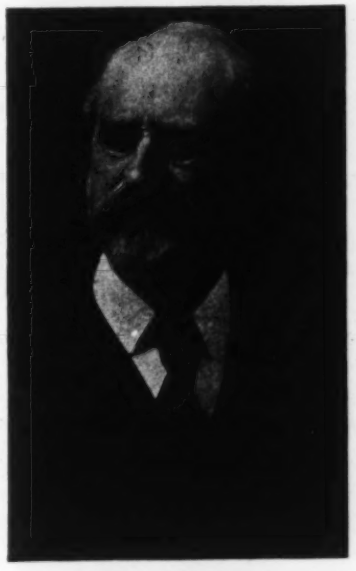
Mayor Mackey of Philadelphia, at the annual dinner of the Philadelphia Society of Municipal Engineers on Feb. 26, presented gold medals to three members of the society. The medals were awarded to George T. Atkinson, assistant director of city transit, "because of his seventeen years of meritorious service to the city and his interest in electric railway construction, operation, management and accounting"; to Edward T. Aitken, for "his 27 years of meritorious service as operator, inspector and chief operator in the electrical bureau and for his collaboration in the changes in the central fire alarm office," and to Thomas Buckley, former president of the society and assistant chief engineer and surveyor.

Clemens Herschel

Veteran Engineer Died March 1—Attained World-Wide Eminence as Hydraulic Engineer, Inventor and Writer

CLEMENS HERSCHEL, past-president of the American Society of Civil Engineers and long recognized as a leading hydraulic engineer, died at his home in Glen Ridge, N. J., on March 1. Although in his 88th year, Mr. Herschel went to his New York office regularly and kept in close touch with professional affairs until a few months ago.

Born in Boston, Mass., on March 23, 1842, Mr. Herschel graduated from the



CLEMENS HERSCHEL

Lawrence scientific school at Harvard in 1860. He then studied three years in France and Germany, being graduated from the Carlsruhe Technical School in 1863. During the years before he found the branch of the profession which he was to advance so markedly he had some diversity of work, centering in Boston and vicinity. He was employed for a time in the Boston sewer department and in 1871 was superintendent of streets in West Roxbury. He won a prize for an essay on road making, given by the Massachusetts Department of Agriculture. In these earlier years of diversified practice he seems to have given most attention to bridge engineering. In 1875 he published "Continuous Revolving Drawbridges." In 1881-83 he was a member of the Massachusetts Railroad Commission.

The first stage of Mr. Herschel's notable work as a hydraulic engineer was from 1879 to 1889. In the first of these years, after service under James B. Francis, he became hydraulic engineer of the Holyoke Water Power Co. In that capacity he rebuilt the Holyoke dam across the Connecticut River, put the sale of water for power to the various local mills on a scientific basis, constructed and operated the famous Holyoke testing flume and, after careful studies, devised the Venturi meter, which has since come into world-wide use for measuring the flow of water in conduits up to any conceivable size. Instead of giving the meter his own name, Mr. Herschel christened it after Venturi, the Italian who many decades before established the principle of the change in pressure incident to water flow through a diverging conduit. For a paper on this meter before the American Society of Civil Engineers Mr. Herschel was awarded the Rowland prize in 1888 and for the invention the Franklin Institute awarded him the Elliott Cressen gold medal.

Mr. Herschel's second period as a hydraulic engineer began in 1889, when he became chief engineer of the East Jersey Water Co. and, as such, built works providing a large additional water supply for Newark and adjoining New Jersey municipalities. These works included dams and reservoirs on the Pequannock River, a riveted steel pipe line and a series of Venturi meters. The job was put through speedily, being accelerated by telephone service not only throughout the work but extending also to Mr. Herschel's New York office, something unusual if not unprecedented on so large a scale in the early nineties. His connection with the East Jersey Water Co. extended to 1900, during which period Mr. Herschel was consultant on the construction of the additional water supply for Jersey City, execution of the contract for which was finally controlled by the company named. The second stage of Mr. Herschel's career merged into the third, with his increasing practice as a consulting engineer. Such engagements included those with power companies at Niagara Falls, extending from 1884 to 1904, advice on the deep pressure tunnel that continues the Catskill aqueduct beneath New York City and many others.

Besides being a lifelong contributor to national society proceedings, *Engineering News-Record* and its predecessors, and writing the book on bridges already mentioned, Mr. Herschel published, in 1897, "115 Hydraulic Experiments," a review of data on the carrying capacity of riveted wrought-iron and steel pipe lines, while two years later appeared his translation of an engineering classic, "Two Books on the Water Supply of the City of Rome," by Sextus Julius Frontinus, one-time water commissioner of the imperial city. This translation, the first into English, was made from a photographic copy of the sole manuscript in existence, located by Mr. Herschel in a monastery. The book includes a facsimile of the manuscript. Among other notable facts disclosed by the translation are that some 2,000 years ago water was sold by measurement in Rome; that consumers tampered with the measuring devices; and that notable as the aqueducts of Rome were, they

supplied much less water per capita than had long been credited to them.

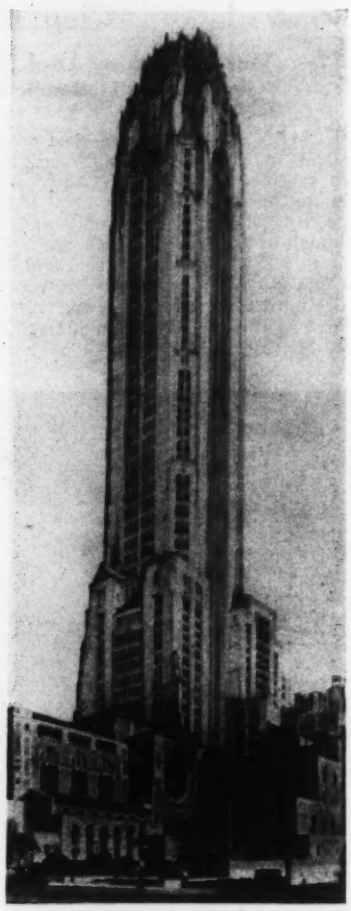
Clemens Herschel was an early member of the Boston Society of Civil Engineers, its treasurer from 1874 to 1880 and its president in 1890-91. Years ago he presented to the library of that society a large collection of lives of engineers, together with some of their contributions to literature. He joined the American Society of Civil Engineers on April 1, 1869, was a director in 1891, a vice-president in 1915-16, and by virtue of that office became president in 1916, on the death of E. L. Corthell. He was made honorary member of that society in 1922 and of the American Water Works Association in 1924. He had been a member of the Institution of Civil Engineers since 1890.

Special Railway Service to Mexican Highway Meeting

Arrangements for railway accommodations for those attending the third highway congress of the National Highway Commission of Mexico, to be held in Mexico City April 20-27, 1930, are being made through the headquarters of the American Road Builders' Association, Washington, D. C. Special cars will leave Washington at 2:55 p.m. on April 15, reaching Mexico City at 5:20 p.m. April 19 by way of St. Louis, San Antonio, Laredo and Monterrey. Although the rain may be boarded at any city en route, reservations should be made in advance through the association.

Work to Be Resumed on Mexican Irrigation System

After a lapse of twenty years, the large irrigation project which was started and partly carried out by Lorenzo Trevino upon his 2,000,000-acre ranch, which borders the Rio Grande for many miles between Piedras Negras and Villa Acuna, is to be completed by the Mexican government, according to authoritative announcement. Engineers have finished making surveys for the proposed main dam and a system of canals and ditches which will cost, it is estimated, 8,000,000 pesos, equivalent to $4,000,000 United States money. The dam will be located on the San Diego River, which is fed by large springs and affords an abundant supply of water. In connection with the irrigation project, a hydro-electric plant will be constructed. It will be of large capacity, designed to supply power for Monterrey, Monclova, Torreon and a number of other cities and towns of the states of Coahuila and Nuevo Leon. There are already two dams and irrigation systems upon the big tract of land, both of which were constructed by Senor Trevino before the Mexican government, under the agrarian law, expropriated the land. The main irrigation system, which the Mexican government expects to get well under way this year, will bring under irrigation approximately 600,000 acres.



CONTRACTS AWARDED FOR 50-STORY BUILDING

Architect's drawing of the new 50-story RCA-Victor Building to be erected on the corner of Lexington Ave. and East 51st St., New York City. The contract for construction of the building has been awarded to the A. L. Hartridge Co., New York City; Cross & Cross are the architects. The tower will rise to a height of 650½ ft., will occupy a plot measuring 111x155 ft., and will be of face-brick and Indiana limestone.

Study Oregon Power Project

A temporary permit, allowing two years to complete investigations, studies and plans before commencing construction, has been issued by Charles J. Bartholet, Washington state hydraulics supervisor, to the Yakima-Klickitat Power Co. for appropriation of 350 sec.-ft. of water from the Klickitat River for a proposed $1,500,000 hydro-electric power project. A diversion dam 20 ft. high and 150 ft. long would be located in Yakima County near the base of Mount Adams, and canals and flumes would carry the water about 9½ miles southeastward to the power plant in northern Klickitat County, where a fall of 600 ft. would be utilized to develop 23,865 theoretical horsepower.

RANDOM LINES

Newspaper Engineering

Fearful and wonderful are the marvels of engineering as described by some of the daily papers. Read, for example, this quotation from a copyrighted article by Garrett P. Serviss describing a high-head power plant in Italy:

> To guard against the mad rush of the water down the one-to-one grade of the chute, which would look absolutely vertical if seen from a short distance in front, it has been necessary to depart from the usual manner of receiving falling water with vertically placed hydro-electric generators, and to partially tame its fury before it strikes by first turning it upward against gravity and then causing it to revolve around water wheels connected with horizontal generators.

Then, too, there is the Australian newspaper which solemnly stated that a heavy rain had caused 3,000 "sluiceheads" of water to rush over the dam. This new unit of measurement should prove extremely useful.

* * *

Flashboards!

"Flashboards," says the *Herald Tribune*, New York, "are a series of wings placed on or at the side of milldams to increase the depth of the water."

Encyclopædia Britannica, please copy!

* * *

Two Overseas Contributions

The *V. D. I. Nachrichten* in a recent issue carries an advertisement of a "Propaganda-Ingenieur." He claims to be a master of the field of technical propaganda in all its branches, to know printing and illustrating, and to be skilled in working out advertisements, circulars and other sales literature, and finally indicates that he expects suitable remuneration.

Another advertisement in the same journal is from a "Berechnungs-Ingenieur," who proposes to work in the field of centrifugal pump construction, but says nothing about pay.

* * *

Engineering English

A hint for engineers on the advantage of a few well-placed adjectives in their reports:

> Giant Farnham Span Taking Form; Work Is Being Speeded
>
> Within the next 30 days a slim white arch bridge of beautiful design will take shape at Farnham and the state and county highway departments will have achieved another step in the march of progress.
>
> Blasting down through solid, flintlike rock at both ends of the new span, two mammoth abutments have been set and already work has started on the pouring of the bridge deck, or what will be the bridge floor.
>
> After the bridge deck, or floor, has been poured all that remains to complete the bridge proper will be the construction of two arches, 150 ft. in length, one on each side of the bridge.
> —*Ashtabula Star-Beacon.*

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

I.C.C. to Push Recapture of Railroad Earnings—Omnibus Bridge Bill Passed by House

A VIGOROUS campaign for the recapture of $150,000,000 in excess railroad earnings is planned by the Interstate Commerce Commission. During the next sixteen months the commission purposes to serve recapture reports on 161 railroads out of a total of approximately 400 that are subject to the provision of section 15*a* requiring that one-half of the railroads' net earnings in excess of 6 per cent shall go into a revolving fund established by the individual roads and one-half to the government for maintaining a general railroad contingent fund.

For the specific purpose of recapturing this excess income, which has gone uncollected for nearly a decade, the commission has requested Congress for an increase from $2,540,000 to $3,547,313 in the budget estimate for its valuation work. This increase is made necessary by the commission's decision, in the light of the Supreme Court's decision in the O'Fallon case and the attitude of the railroads, to adhere to ordinary trial procedure in the determination of recapturable amounts instead of adopting the conference method used to some extent in fixing the primary valuation of railroad properties. Several cases already have been assigned for hearing.

Control or Consolidation?

Instructions given to the Pittsburgh & West Virginia Railway and the New York, Chicago & St. Louis Railway relative to their conflicting applications to acquire control of the Wheeling & Lake Erie Railway indicate that the Interstate Commerce Commission will not approve further applications for acquisition of controlling interest under paragraph 2 of section 5 of the interstate commerce act without some assurance that the road intends to follow through later with an application under paragraph 6 for effecting an actual consolidation. In the present instance, the commission's immediate purpose is to learn whether, as reported, the Pennroad Corporation has acquired a controlling interest in the Pittsburgh & West Virginia. The Nickel Plate and the Pittsburgh & West Virginia must be prepared at the hearing on their applications March 10 to furnish the commission with full information regarding intercorporate relationships and interlocking directorates.

The character of this and other information sought by the commission on these applications for acquisition of control is much the same as that to be required under applications to consolidate. It is evident that the commission is considering the probability that, once a road has acquired control of a desired property, it may never intend to take the further step necessary to effect an actual consolidation. Oftentimes control is sufficient for practical purposes, and consolidation, furthermore, is hedged by more restrictions than acquisition of control. Under paragraph 2 it is necessary to show only that the proposed acquisition of control is in the public interest, while maintenance of competition with other systems and a total capitalization that does not exceed the value of the combined properties are among the conditions which attach to effecting actual consolidation under paragraph 6.

Planning a Railway for Heavy Traffic

Describing the Loree project as a super-railroad to be built and operated according to the highest state of the railroad art, the New York, Pittsburgh & Chicago Railroad has submitted to the Interstate Commerce Commission a brief in support of the construction of the proposed cross-state Pennsylvania line from Allegheny City to Easton, 283 miles. The brief presents many arguments in favor of its construction that are interesting from an engineering standpoint. The road has no eastbound grade exceeding 0.3 per cent, no westbound grade over 0.4 per cent and its highest summit level is 1,560 ft. Besides having easier grades than any other road, not excepting the water-level route of the New York Central, the road will have exceptionally moderate curvatures. There is to be no curve sharper than 4 deg., and the average curvature per mile is to be 20 deg. The entire line would be laid with 127-lb. rail, except sidings, and will be double tracked. Public highway crossings at grade will be avoided, provision having been made for 107 separated-grade highway crossings, an average of one to every 2.6 miles for the full length of the line.

The line would be shorter than any other road between Pittsburgh and New York and shorter than any other between Chicago and New York, except the Pennsylvania, which has an advantage of 4 miles. The route would be 79 miles shorter than the proposed route of the Baltimore & Ohio between New York and Chicago. While all the other roads possess the enormous disadvantages of their venerable history, the brief states, the new road would be the only one ever built in a region of dense general traffic that from the beginning would be planned and constructed to handle a very large volume of traffic with the greatest possible economy in operation.

Estimates of operating expenses and traffic place the operating ratio of the proposed line at 40.47 per cent, a figure that, the brief asserts, is not approximated anywhere in American railway experience. The cost of the road, fully equipped, is estimated at $177,740,373, which at 5¼ per cent would result in an annual capital charge of $10,220,071. Annual operating expenses of $12,006,443 and taxes of $1,738,400 would bring the total cost of supplying 3,689,549,888 ton-miles of freight transportation up to $23,964,914, or an average of 6.5 mills per ton per mile. The claim is made that no railroad, except possibly in the Pocahontas region where a large tonnage of bituminous coal is carried by roads of relatively low capital cost, is capable of carrying freight for as little as 6.5 mills for capital charges, taxes and operating expenses. Contending that the existing roads have no vested right to exemption from the competition of a new line of highly superior type and unequaled efficiency, the brief argues that the prospective growth of freight traffic in the region requires additional facilities of that type.

The Business Outlook

Business is borrowing money for current requirements at rates only slightly lower than it had to pay before the stock-market crash. Such easing of rates as has taken place so far has been felt almost wholly in the call and acceptance market. The news from the mortgage market is that mortgage money is no cheaper than it was before the crash. A factor that has helped to make conditions easier at some points is the return to savings banks of deposits withdrawn during the boom months, and building and loan associations report that they, too, are getting some of their funds back. In some sections of the country banks are considering paying lower rates to depositors.—*Results of a survey by "The Business Week," March 5.*

River and Harbor Funds

Preparation of the new rivers and harbors bill has about been completed by the House committee. The measure proposes an authorization of approximately $150,000,000 to apply on projects throughout the country. The details of the bill will be withheld until it is reported to the House. The proposed appropriation is no larger than that of recent years, it is pointed out, as there has been no rivers and harbors bill for the past three years.

Bridge Bills Combined

In order to expedite the handling of various bridge bills by the House, an omnibus bill was drafted by the interstate commerce committee and was passed on Feb. 17. This bill contained all the measures granting approval for bridge construction that previously had been placed on the House legislative calendar, and also the various bills extending the time for completion for projects already approved. All of the bridges authorized by the omnibus bill are to be constructed by private individuals or companies and are to be operated as toll bridges.

The War Department has signified

its approval of all of the bridges contained in the act. The Bureau of Public Roads, however, has filed an objection to the construction of each bridge on the ground that they are to be constructed by private capital and will be used as toll bridges. Provision is made in all cases for the regulation of tolls, for an accounting as to the cost of construction and for recapture of the bridge by public authority.

Among the bridge crossings included in the act are the following: Columbia River at Astoria, Ore.; Mississippi River at Savanna, Ill., and Helena, Ark.; Missouri River at South Omaha, and Omaha, Neb.; Monongahela River at Fayette City, Pa.

Personal Notes

MILO R. MALTBIE, of New York City, has been appointed by Governor Roosevelt chairman of the New York State Public Service Commission. Mr. Maltbie was a member of the original Public Service Commission from 1907 to 1915.

I. V. DAPPERT has resigned his position as assistant construction superintendent for the Cuban Electric Co. (Compañia Cubana de Electricidad) at Havana, Cuba, and is now in charge of the newly opened office at Springfield, Ill., of the consulting engineering firm of J. W. Dappert & Sons, of Taylorville, Ill.

HAVEN STANLEY ALE, of Altoona, Pa., has been named superintendent of the Altoona city water bureau, succeeding the late C. B. Campbell. Mr. Ale during the past ten years has been associated with D. W. Dillman, civil and mining engineer, of Altoona.

CHARLES C. WILSON, architect and engineer, of Columbia, S. C., has been appointed by the U. S. Commissioner of Education a member of the national advisory council on school building problems.

D. L. HOGAN has been appointed engineer for the highways of Van Zandt County, Texas.

HENRY CANTY has been named county engineer of Mason County, with headquarters in Shelton, Wash., suceeding W. H. Wiley, resigned. Mr. Canty has been engineer for the Simpson Logging Co. in that city for a number of years.

HENRY F. STUBBS, of San Antonio, Tex., formerly construction engineer for the Sumner Sollitt Co., has been employed by the J. G. White Engineering Corporation on irrigation development for the Chilean government. Mr. Stubbs is located at Parral, Republic of Chile.

HARLAND BARTHOLOMEW, consulting engineer for the St. Louis (Mo.) City Plan Commission, has been selected adviser for the city planning committee of the National Association of Real Estate Boards during the coming year. W. W. Butts, of St. Louis, chairman of the committee, has announced it has selected as one of its chief topics of investigation this year the effects of street-widening projects on real estate values.

ROY S. MACELWEE, for the past six years port commissioner of Charleston, S. C., is now associated with J. Stuart Crandall, Cambridge, Mass., in the civil and industrial engineering firm of MacElwee & Crandall, Inc. The new firm will act as consultant in matters relating to lake, river and ocean waterfront development, port and port city planning and zoning. Mr. MacElwee was director of the U. S. Bureau of Foreign and Domestic Commerce from 1919 to 1921, and from that time to 1924 was dean of the school of foreign commerce at Georgetown University, Washington, D. C.

Society Calendar

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; annual meeting, Chicago, Ill., March 11-13.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; regional meeting, Detroit, Mich., March 19.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Sacramento, Calif., April 23-24.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, St. Louis, Mo., June 2-6.

AMERICAN WELDING SOCIETY, New York; annual meeting, New York City, April 23-25.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; annual meeting, Augusta, Ga., March 31-April 2.

INTERNATIONAL CONGRESS OF BUILDING AND PUBLIC WORKS, London; fifth congress, London, England, May 26-30.

INTERNATIONAL RAILWAY CONGRESS, Madrid, Spain, May 5-15. American vice-president, T. S. Morgan, 119 West 42d St., New York.

WORLD POWER CONFERENCE, second plenary meeting, Berlin, Germany, June 16-25. American secretary, O. C. Merrill, Washington, D. C.

CANADIAN SECTION, American Water Works Association, will hold its annual meeting March 12-14 at Hamilton, Ont.

HIGHWAY ENGINEERS' ASSOCIATION OF MISSOURI at its 23d annual meeting re-elected C. W. Brown president and Charles H. Swift secretary-treasurer. New vice-presidents chosen were Roy Leslie, Moss Edwards and Tom Parks.

INDIANA ENGINEERING SOCIETY in session at Lafayette elected Charles Brossman president, E. L. Eriksen vice-president and W. A. Knapp secretary-treasurer. Mr. Brossman has been secretary-treasurer of the society for the past twenty years.

INDIANA SECTION, American Water Works Association, will meet March 20-21 at Purdue University, Lafayette. The program will include problems of every type of plant from simple pumping installations to complex purification works, with a whole session for the plant operator. C. K. Calvert, Indianapolis, is secretary.

LITTLE ROCK ENGINEERS CLUB (Ark.) has chosen the following officers for 1930: president, Hugh R. Carter; vice-president, R. A. Kern; secretary-treasurer, Fred L. Hargett.

NATIONAL DRAINAGE CONGRESS held its nineteenth annual meeting Feb. 19-21 at St. Louis. Flood prevention in the Mississippi Valley was the main topic of discussion, the consensus of opinion being that proper control could only be secured by means of a combination of levees, channel improvements and reservoirs. The following officers were elected: president, W. G. Potter, Evansville, Ill., drainage engineer, Illinois division of waterways; first vice-president, B. F. Williams, Austin, Tex., state reclamation engineer of Texas; and William Crooks, Little Rock, Ark., Louisiana & Arkansas Railroad; treasurer, E. G. Jaques, Kansas City, Mo., American Steel & Wire Co.

NEW JERSEY SEWAGE WORKS ASSOCIATION will hold its annual meeting March 21-22 at Trenton. J. R. Downes, Bound Brook, is secretary.

NEW YORK STATE CHAPTER, Associated General Contractors, highway division, will hold its annual convention March 12-13 at Syracuse, N. Y.

Obituary

CLARENCE M. FOSTER, for the past ten years Pacific Coast manager for the Barber Asphalt Co., died Feb. 18 in San Francisco, Calif. at the age of 63. Mr. Foster was a member of the American Society of Civil Engineers.

JULIUS HOCKE, a civil engineer, of Bayonne, N. J., died in that city on Feb. 21. He had been connected with the Lehigh Valley Railroad, the General Contracting & Engineering Co., of New York, and the Barney Ahlers Corporation, of New York.

GUY STERLING, of Salt Lake City, died on Feb. 23. Mr. Sterling, who was 70 years old, went to Yakima, Wash., in 1891, where he was engaged in the construction of the Sunnyside Canal. Later he was chief engineer on the construction of the Priest Rapids project on the Columbia River. He had lived in Utah since 1925.

HECTOR J. HUGHES, since 1920 dean of the school of engineering of Harvard University, died on March 1, aged 59. Professor Hughes, before joining the Harvard faculty in 1902, saw service as engineer for the Chicago, Burlington & Quincy Railroad and with the American Bridge Co. From 1914 to 1918 he was professor of civil engineering at the Massachusetts Institute of Technology contemporaneously with his position at Harvard. He was active in the reorganization of the Harvard engineering courses and was a member of many professional societies, including the American Society of Civil Engineers, the American Society for Testing Materials, the Society for the Promotion of Engineering Education and the Boston Society of Civil Engineers.

WILLIAM E. MCCLINTOCK, of Chelsea, Mass., one of the pioneer good roads advocates of the country, died on March 2. He was 81 years old. In 1892 Mr. McClintock was appointed highway commissioner of Massachusetts and he was the first president of the Massachusetts Highway Association. From 1867 to 1876 he was with the U. S. Coast Survey, surveying many of the principal harbors of the Atlantic coast. From 1880 to 1890 he was city engineer of Chelsea. After the disastrous fire in Chelsea in 1908 Mr. McClintock was appointed by Governor Draper chairman of the board of control, which was directed to conduct the business and government of the city during the reconstruction period. The board rebuilt all the public buildings and laid out new street lines. He was a member of the American Society of Civil Engineers and past-president of the Boston Society of Civil Engineers.

Construction Equipment and Materials

Standard Load Table Issued for Steel Joist Construction

To eliminate confusion in the design of steel joist construction caused by the fact that joists made by different manufacturers vary considerably in capacity, the members of the Steel Joist Institute have agreed that their products shall conform to standards contained in a loading table issued by the Institute, copies of which may be obtained from its office at Detroit, Mich. Although joists vary in details of design, each will have a resisting moment and reaction not less than those shown in the standard loading table. Catalogs issued after Jan. 1, 1930, will carry the Steel Joist Institute number, as given in the table, as well as the manufacturer's own system of numbering his product.

Large Turbine Pump Built for Use in Mexico

Water will be lifted approximately 850 ft. by a large turbine pump recently constructed by the Pomona Pump Co., Pomona, Calif., for the Cia Industrial el Potosi for installation at Zacatecas, Mexico. The shipment required two railway freight cars and weighed 48,000 lb. without the electric motor. From the top of the motor to the lowest portion of the pump bowls the distance is 864 ft. The problem of proper lubrication and prevention of whipping in a drive shaft of such great length was solved by using a water-lubricated resilient type bearing. The shaft floats within a film of water which acts as a cushion to reduce vibration. The manufacturers deviated from the more common method of surrounding the shaft with an oil tube or using oil as a lubricant because the braking effect, due to the viscosity of the oil, would have meant a great loss of power.

DRIVING HEAD AND MOTOR OF LARGE TURBINE PUMP

Twenty-five individual pump stages on bowls are used. Twelve of these are installed about 400 ft. underground; the remainder at the 833-ft. level. Only one shaft is used, as the separate sets of stages drive from the same motor mounted at the surface. The capacity of each set is synchronized. A regulating device installed immediately below the top group compensates for increase in shaft length as the hydraulic load increases. The impellers have no lower shroud and are adjustable from the surface to compensate for eventual wear. All moving parts are supported by a roller bearing in the pump head which runs in oil, the temperature controlled by water-cooling coils.

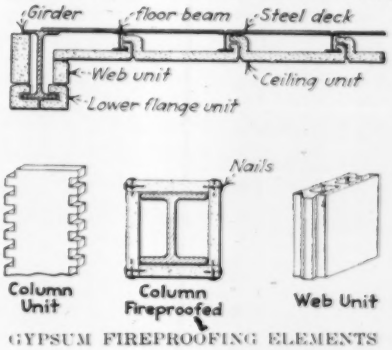
New Developments

Gypsum Units for Fireproofing Battledeck Floors

Many advantages are claimed for a series of gypsum fireproofing units designed by Lee H. Miller, chief engineer of the American Institute of Steel Construction, Inc., and manufactured by the Rockwood Corporation of America, St. Louis, Mo. Although developed primarily for use with the new type of battledeck all-steel floor construction, this fireproofing is also applicable to other types of steel floors. Advantages claimed for gypsum are that it can be nailed, bored, planed and drilled with carpenter tools, that it is fireproof, vermin proof and free from decay, and that it is superior as a heat insulator.

The fireproofing is made in a number of forms which, properly arranged, give full protection to the steel floor system, as is shown in the illustration. As all edges are machine finished, smooth joints are obtained, which eliminate the necessity for a separate ceiling treatment. A thin coat of plaster can be applied by simply dampening the gypsum to reduce suction, or, if preferred, the joints can be closed with joint filler and the ceiling finished with a textured paint.

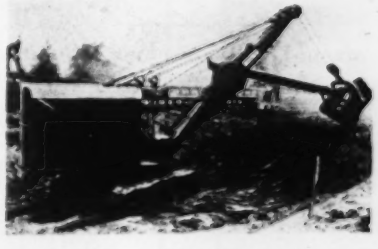
The battledeck floor recently developed by the American Institute of Steel Construction consists of steel plates welded to each other and to the top flanges of I-beams spanning from girder to girder of the structural steel frame of the building. Dimensions vary with loading conditions and the size of the bays, the usual construction consisting of 3- to 5-in. I-beams covered by continuous steel plates ⅜ or ½ in. in thickness. The finished floor requires from 13 to 15 lb. of steel per square foot and an equal weight of gypsum fireproofing. It is said to be lighter and cheaper than the present form of fireproofing construction, has approximately one-third the thickness, can be erected much more rapidly than other types of fireproof floor construction and can be utilized as a working floor as soon as the plates are laid and tack-welded. It also has a weight of considerably less than one-half as much as the standard circular arch construction now in general use.



GYPSUM FIREPROOFING ELEMENTS

1¼-Cu.Yd. Excavator Improved

Many refinements are embodied in the new improved heavy-duty 1¼-cu.yd. excavating machine announced by the Thew Shovel Co., Lorain, Ohio, known as the Lorain 75-B. These improvements may be divided into two general classes, those on the turntable and those on the crawler mounting. Turntable changes consist of a general increase in the size of parts, together with larger and more powerful power plant. Optional motor equipment includes a Waukesha 97-hp. gasoline engine, a 7x8½-in. Atlas Imperial diesel engine, or an a.c. or d.c. electric motor. Power is transmitted through a power takeoff and silent chain drive directly to the center drive pinion which motivates hoist, swing and travel or crowd. These motions are controlled by newly designed, simplified internal expanding clutches.



1¼-CU.YD. EXCAVATOR WITH SHOVEL RIG

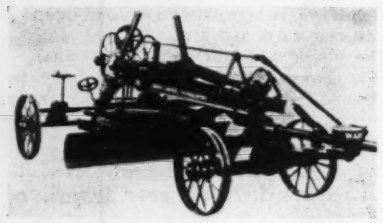
In the crawler mounting the major changes comprise larger and heavier crawlers, new steering and traveling clutches mounted on splined sections of a horizontal propelling shaft of increased diameter, a heavier, more rigid car body, and larger axles. Although

the standard crawler tread has been lengthened, if further reduction in ground pressure is necessary the machine may be fitted with the new extra length treads described in *Engineering News-Record*, Dec. 5, 1929, p. 906.

Other improvements in the 75-B include an automatic power trip on the dipper of the shovel unit, a new fairlead for the dragline with Timken roller bearings and a simplified boom design for the backdigger.

New Pull-Type Grader Announced

An 8-10-ft. grader weighing approximately 5,600 lb. for use with tractors from 20 to 50 hp. has been added to the line of the W. A. Riddell Co., Bucyrus, Ohio. This is known as the Warco model 2-G. Design features include

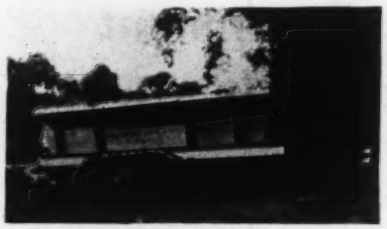


8-10-FT. ROAD GRADER

screw-lift blade control, I-beam frame, leaning wheels front and rear, one-piece cast-steel circle, adjustable power hitch, centralized controls at the operator's platform, Timken bearings on all wheels and a special ball-and-socket framehead. The latter consists of a heavy socket fitting over a ball, the assembly forming a universal pivot for the front end of the grader. Controls are actuated by hand wheels operating through inclosed worms and gears.

Bottom-Dump Wagons Mounted on Crawler Treads

Production of a line of 5- and 7-cu.yd. crawler-type dump wagons, to be known as Cat-Tread wagons, has been announced by the Davenport Locomotive & Manufacturing Corp., Davenport, Iowa. These use treads of the crawler type, and are designed for conditions too severe for the use of ordinary round-wheel dump wagons. The 5-cu.yd. size weighs 8,400 lb. and is mounted on a single pair of crawler treads. The larger wagon, carrying 7 cu.yd., weighs 10,500 lb. and can be obtained with or without a pair of wide-tire steel wheels in addition to the crawler treads. Capacities of both wagons are based on level measure and can be increased by the application of an auxiliary sideboard on the low side of the dump body. As produced at present, the wagons are equipped with bottom dumps operated by hand from the rear. Doors drop vertically, permitting free discharge of the load. In the future further models will be added to include a three-way



5-CU.YD. CRAWLER DUMP BODY

dump body for use on jobs where it is necessary to dump over the edge of a fill or where other conditions make a bottom dump undesirable.

The main frame of the wagon consists of a 9-in. ship channel to which is riveted an alloy steel casting axle hanger. To prevent bulging, a tie rod extends across the frame and is secured to the axle hangers. One-piece wheels carrying the treads are assembled in an H-frame which, it is claimed, keeps the wheels in constant alignment and prevents damage to axles when operating over uneven ground. The tread assembly is of special analysis steel with unusual wear resisting qualities.

Business Notes

PERMUTIT CO., New York City, has appointed M. F. Corin general sales manager. Mr. Corin has been for fourteen years Philadelphia district sales manager for the company.

RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, Ohio, is now using electrically welded bases for the motor generator sets which it manufactures.

BYERS MACHINE CO., Ravenna, Ohio, has appointed the Edward R. Bacon Co. sales representative in San Francisco and northern California.

TRUSCON STEEL CO., Youngstown, Ohio, has appointed Charles A. Haynes manager of its transmission structures division.

GOODALL RUBBER CO., Philadelphia, Pa., has opened a branch office in Cleveland, Ohio, under the management of T. S. Stewart.

CUTLER-HAMMER, INC., Milwaukee, Wis., has appointed Frank J. Burd manager of its Philadelphia office, succeeding T. E. Beddoe, resigned.

C. F. PEASE CO., Chicago, Ill., has appointed W. Earle Pashley assistant sales manager and second vice-president. Mr. Pashley, who will continue his duties as advertising manager of the company, has also been elected to the board of directors.

WEST COAST LUMBERMAN'S ASSOCIATION Seattle, Wash., has elected the following officers: president, J. D. Tennant; vice-presidents, F. R. Titcomb and Myron C. Woodard; treasurer, R. W. Vinnedge; secretary-manager, W. B. Greeley.

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., has won the Harvard award established by the late Edward W. Bok for the "general or institutional advertising campaign conspicuous for the excellence of its planning and execution."

A. G. REEVES STEEL CONTRUCTION CO. is the new name of the organization formerly known as the Reeves Brothers Co. No change in corporate structure or organization is involved.

KALMAN STEEL CO., Chicago, Ill., has elected Paul J. Kalman chairman of the board, George E. Routh, Jr., president, and A. P. Clark vice-president in charge of sales.

CHICAGO PNEUMATIC TOOL CO., New York City, has opened a branch office at Tulsa, Okla., in charge of George J. Lynch, district manager.

BAY CITY SHOVELS, INC., Bay City, Mich., announces the following appointments: C. C. Johnson, Marion, Ind., has been appointed district sales maanger for Indiana and Ohio; C. H. Collier, Dallas, is district sales manager for the State of Texas; R. D. Alrich is now agency sales manager in charge of all distributors in the central district, with headquarters at Bay City. Eastern Contractors Equipment Co., Frederick, has been appointed distributor for the State of Maryland.

C. GRADY CATES, who has for a number of years conducted an engineering sales business representing manufacturers of building products, has joined the Stone-Tile & Supply Co., Roanoke, Va., as chief engineer and sales manager.

MORTON R. HUNTER, president of the Hunter Machinery Co., Milwaukee, Wis., has been appointed a member of the trade practice conference of the concrete mixer and paver industry.

NATIONAL EQUIPMENT CORP., Milwaukee, Wis., announces the addition to its group of the C. H. & E. Mfg. Co., also of Milwaukee, manufacturer of saw rigs, pumps, hoisting machinery, material elevators and mortar mixers. Frank F. Hase, president of the C. H. & E. Mfg. Co., becomes vice-president and director of the National Equipment Corp.

New Publications

Wrought Iron—*Wrought Iron Record* is the title of a new trade magazine being published by the WROUGHT IRON RESEARCH ASSOCIATION, Pittsburgh, Pa.

Recording Gages—Elements of construction used in recording pressure and vacuum gages are fully described in a 91-p. illustrated catalog issued by the BRISTOL CO., Waterbury, Conn.

Sheet Iron—Corrosion is particularly severe along the seacoast. How to combat this effect by the use of pure iron in waterfront structures is outlined in a 12-p. illustrated bulletin issued by the AMERICAN ROLLING MILL CO., Middletown, Ohio.

Paint—"The value of any paint can be determined only by experience. An efficient paint cannot be invented and compounded merely by theoretical reasoning. Paint making, as well as painting, is an art and not a science."—A. H. Sabin, in "Structural Metal Painting," a 75-p. pocket-size booklet issued by the NATIONAL LEAD CO., New York City. The principal contents of the booklet consist of an analysis of various corrosion factors, discussions of such technical considerations as pigments and oil proportions, descriptions of types of paint and of methods of estimating areas and costs, of mixing, and of writing specifications.

Electrical Machinery and Welding Apparatus—How to solve power factor problems by means of a graphical method using a right-angle triangle and an easy method of determining the cost of operating electrical appliances and motors are described in two recent publications of the GENERAL ELECTRIC CO., Schenectady, N. Y., which has also issued data sheets describing gasoline-engine driven arc welders of 200- and 300-amp. capacities and large illustrated descriptive booklets on the subjects of electric equipment for handling heavy materials, synchronous motors and floodlighting.

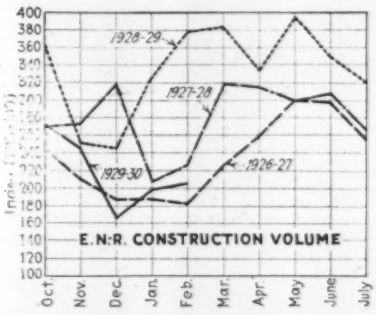
Pipe Welding—"Fabrication of Welded Piping Designs" is the title of an 86-p. illustrated book published by the LINDE AIR PRODUCTS CO., New York City, and intended to supplement an earlier booklet, "Design Standards for Oxwelded Steel and Wrought-Iron Piping." The latter is intended for engineers and architects who design piping systems; the new publication is for the use of the executive, welder foreman and welder in applying and fabricating the fundamental designs described. The booklet contains procedure controls for line joints and fittings, templet layouts for pipe fittings and tables for estimating costs.

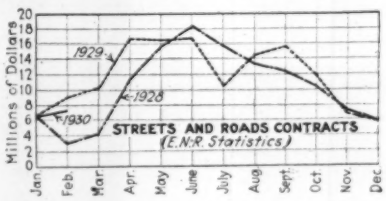
Electrical Apparatus—Recent publictions of the WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., include the following: leaflets describing the operation of the Boston & Maine electrified line through the Hoosac tunnel, the flexibility of the single-phase system of railroad electrification as exemplified on the Great Northern Railway, and the application and design of centrifugal, double-suction, volute-type circulating pumps; circulars describing high-capacity oil circuit breakers and electrical equipment for rotary drilling; and catalogs describing outdoor apparatus insulators and commercial lighting equipment for interior use. This company has also issued an 12-p. illustrated bulletin on the arc welding of cast iron, recommending procedure to be followed for satisfactory results on this type of work.

The Business Side of Construction

Private Lettings Far Below Normal; Public Work Up

THE average weekly value of contracts awarded for engineering construction in 1929 was 76 millions. For the first three months of that year the average was 85; for January-February, 1930, the rate is 48, a decrease of 43 per cent. The per cent difference in actual volume between each of the last six months and the corresponding month of the year before was: September, +15; October, —25; November, —2; December, —32; January, —40; February, —45.





Awards in January and February last year averaged 79 and 91 millions, respectively; in 1930 they were 48 and 49. The first two weeks of last month were extremely slow, but the latter two weeks registered a definite pick-up which has continued in the first week of March.

Analysis of the February figures shows the decline to be wholly in private construction. Public works are 13 per cent more than in February, 1929, and 28 more than in 1928. Private work, on the other hand, is 60 per cent under last year and 23 under 1928.

The South has the best showing, with both private and public work ahead of last February, and is the only section reporting an increase in private work. The Middle West reports the only decrease in public lettings.

Road and street letting, amounting to 14 per cent of total engineering construction, showed the highest January value for the last four years, while February's was the lowest. The two months total 61 millions, compared with 74, 90 and 61 for the preceding three years.

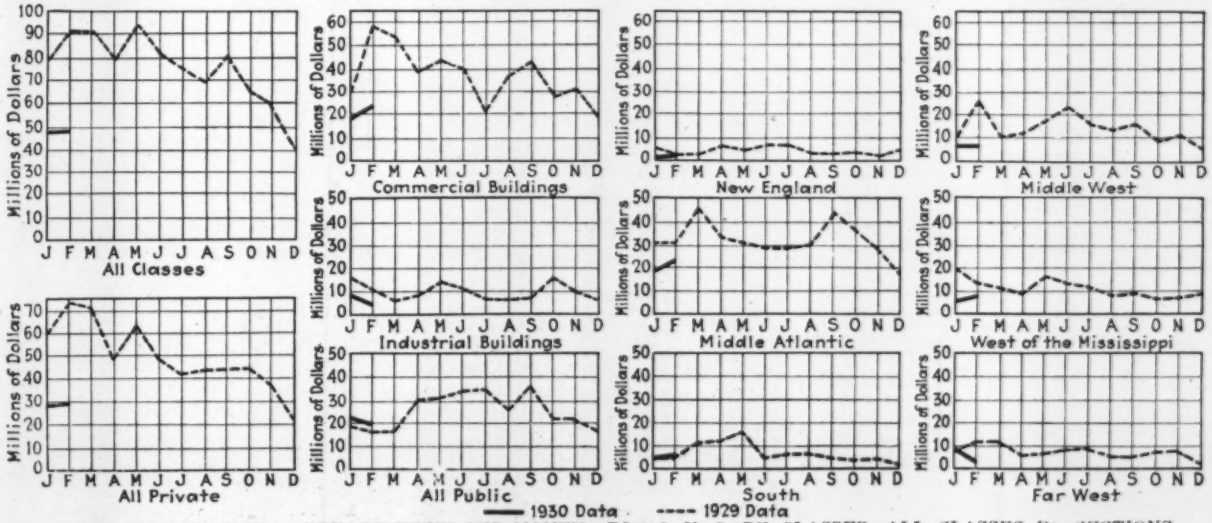
Unemployment Figures Indicate Marked Slackness

Business conditions are vitally affected by the labor situation, and unfortunately employment data are far from complete. On Feb. 19 the Department of Labor reported commercial and industrial unemployment, including manufacturing, mining and quarrying, public utilities, wholesale and retail trades, 5 per cent greater than a year ago. The American Federation of Labor announces that 22 per cent of

VALUE OF CONTRACTS AWARDED IN THE UNITED STATES AND TOTAL FOR CANADA, FEBRUARY, 1930

Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States			Canada, February, 1930
							February, 1930	Year to Date 1930	Year to Date 1929	
Water-works	$15	$602	$231	$508	$1,064	$411	$2,831	$7,658	$7,465	$3,828
Sewers	188	525	757	483	1,764	657	4,374	12,780	11,641	190
Bridges, private		450			25		475	1,475	2,833	
Bridges, public	50	6,138	256	623	1,309	429	8,805	16,603	10,411	
Excavations		215	576	130	995		1,916	5,245	11,864	750
Streets and roads		8,882	4,260	3,090	8,587	4,116	28,935	61,087	43,309	800
Industrial buildings	1,433	3,179	852	5,205	2,380	3,168	16,217	54,939	125,788	750
Commercial buildings	2,800	57,080	2,649	10,893	7,135	3,474	84,031	157,087	324,069	1,595
Public buildings	1,498	5,550	250	2,287	2,205	2,099	13,889	36,478	58,651	1,245
Federal government	1,066	625	2,390	174	3,009	763	8,027	17,561	12,514	
Unclassified, private	1,600	2,768	9,021	599	2,200	50	16,238	39,330	142,167	1,485
Unclassified, public	44	8,766	124	384	76	256	9,650	24,081	10,904	2,527
February, 1930, 4 weeks	8,694	63,477	21,366	24,376	30,749	15,423	195,388			13,170
January, 1930, 5 weeks	7,353	96,510	22,932	34,266	32,456	45,419	238,936			14,712
February, 1929, 4 weeks	12,793	126,306	18,386	104,814	51,768	50,716	364,783			14,107
Year to date, 1930	16,047	191,290	44,298	58,642	63,205	60,842		434,324		27,882
Year to date, 1929	39,866	282,664	39,339	157,125	152,345	90,277			761,616	25,354



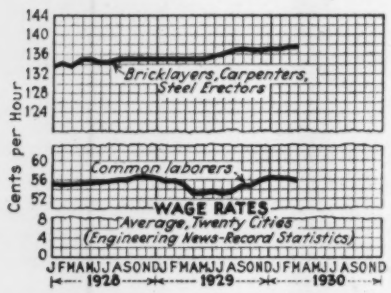
CONTRACTS AWARDED—AVERAGE WEEK PER MONTH—TOTAL U. S. BY CLASSES—ALL CLASSES BY SECTIONS

its membership is unemployed, an increase of 42 per cent over a year ago. In the building trades, says the A. F. of L., 43 per cent of the union workers are out of work, 30 per cent more than a year ago and 10 per cent more than in 1928.

An independent survey of unemployment in the New York City building trades by the Building Trades Employers Association and the Building Trades Council agrees closely with the A. F. of L. percentage for the country. Both employers and unions in New York agree that unemployment here amounts to 40 to 50 per cent of the 179,000 union membership. What this means for the country in terms of number of men out of work can be estimated from the incomplete occupational figures issued by the Bureau of the Census for 1920 covering number of men in various occupations as follows:

Apprentices to building and hand trades	73,897
Brick and stone masons	131,257
Carpenters	887,208
Engineers, stationary, crane and hoistmen	279,940
Building, general laborers	608,075
Painters, glaziers and varnishers	248,394
Plasterers and cement finishers	45,870
Plumbers and gas and steam fitters	206,715
Roofers and slaters	11,378
Stone cutters	22,096
Structural ironworkers	18,836
	2,533,666

Taking the present number as 2,550,000, at least a million men are out of work in the building trades alone. On structures other than buildings there is probably normal employment for this season, with the possibility of increased employment on roads and other public works (contracts 8 per cent above last year). Estimates of total unemployed in all industries range from three to five millions.


Cents per Hour
Bricklayers, Carpenters, Steel Erectors
Common laborers
WAGE RATES
Average, Twenty Cities
(Engineering News-Record Statistics)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

Factory Unemployment—Despite conflicting opinions, there is little doubt that unemployment in the manufacturing industries is somewhat greater than it has been in several years. According to Department of Labor statistics, employment was on a fairly straight line at 100 (average 1923-25) from early in 1925 to November, 1929, when a drop of 3½ per cent was followed in December by a drop of 3 per cent. The decrease in payrolls was somewhat larger, due to an effort to employ as many men as possible, with consequent decrease in working time.

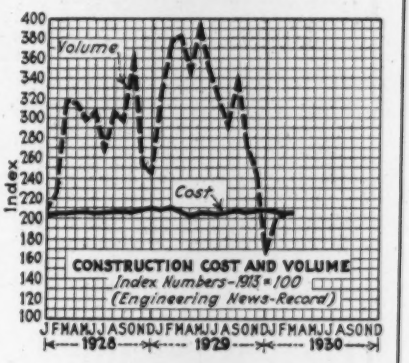
In the middle of 1924 industrial production, employment, payrolls and stock prices factors were at low points, and production and employment were at the same level. Production rose rapidly above both employment and payrolls, and in 1928 and 1929 the trend of production was closely similar to the trend of stock prices. All four are down at present.

Construction Cost and Volume Index Numbers

Higher cement prices in the Middle West (+10c. in Chicago) accounts for the slight rise in the Cost Index. Average wage for common labor in February was 56.15c., compared with 56.28 in January. Contract volume is 2½ per cent above January and 33 per cent under February, 1930.

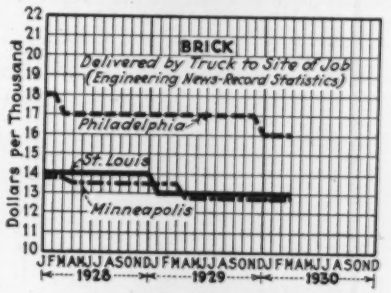
E. N.-R. Cost		E. N.-R. Volume*	
Mar., 1930	206.80	**Feb., 1930**	204
Feb., 1930	205.46	Jan., 1930	199
Mar., 1929	207.78	Feb., 1929	378
Peak June, 1920	273.80	1929 (average)	317
1929 (average)	207.02	1928 (average)	287
1913 (average)			100.00
1929		1929	
January	209.40	January	325
February	210.40	February	378
March	207.78	March	382
April	203.40	April	332
May	205.15	May	395
June	205.65	June	347
July	204.77	July	320
August	205.91	August	290
September	207.57	September	340
October	206.32	October	273
November	208.46	November	245
December	209.46	December	166
1930		1930	
January	208.96	January	199
February	206.46	February	204

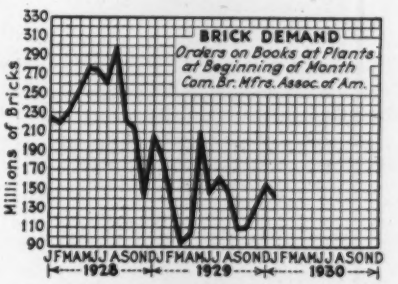
*Corrected for price change since 1913.

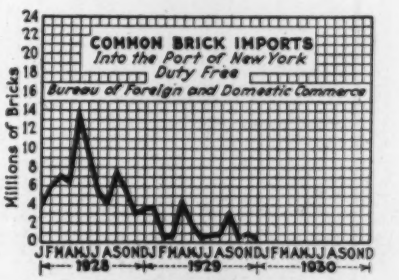

Volume
Cost
Index
CONSTRUCTION COST AND VOLUME
Index Numbers-1913=100
(Engineering News-Record)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

Materials Markets

Brick—The weakest market is common brick, with small probability of change, since all-year plants and container-car deliveries have removed former scarcities. In New York, brick is cheapest since 1918. Trend of im-


BRICK
Delivered by Truck to Site of Job
(Engineering News-Record Statistics)
Dollars per Thousand
Philadelphia
St. Louis
Minneapolis
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930


BRICK DEMAND
Orders on Books at Plants at Beginning of Month
Com. Br. Mfrs. Assoc. of Am.
Millions of Bricks
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930


COMMON BRICK IMPORTS
Into the Port of New York
Duty Free
Bureau of Foreign and Domestic Commerce
Millions of Bricks
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

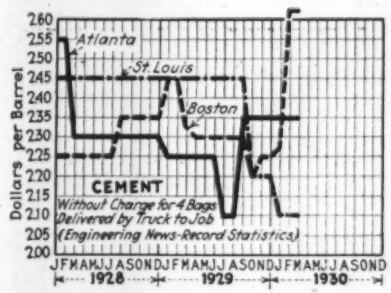
BRICK PRICES, CONSUMPTION, AND IMPORTS

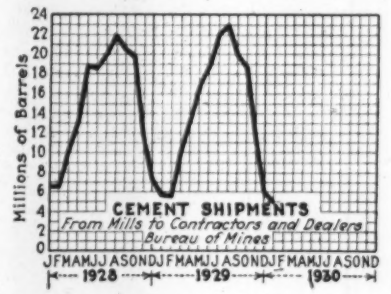
CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

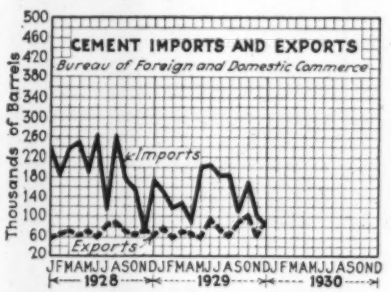
Advances since last month are indicated by **heavy type**; declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor*
Atlanta	$1.25@1.40	$0.60@.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.75	1.00@1.10	1.00@1.37½	.65	$1.00	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.25	.20@.35
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.62½	1.40	1.40	1.00	1.40	1.40	.40@.60
Chicago	1.70	1.62½	1.62½	.97½	1.62½	1.62½	.97½
Cleveland	1.62½	1.37½	1.37½	.87½	1.10	1.50	.40@.87½
Dallas	1.67½	1.12½	1.25	**.40** @ .75	1.25	1.25	*.30*@.50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00	.....	1.25	.62½
Detroit	1.56½	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.37½@.60
Kansas City	1.50	1.37½	1.25@1.37½	.90	1.25	1.37½	.40@.75
Los Angeles	1.25	1.00	1.00	.62½@1.12½	.87½	1.00	.50
Minneapolis	1.25	.87½@.95	.87½	.75	.....	1.00	.45@.60
Montreal	1.25	.80	.75	.....	.90	1.00	.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.87½	1.65	1.92½	1.18¾	1.10@1.23¾	1.92½	1.03¾
Philadelphia	1.75	1.50	1.02½	.70@1.12½	1.00	1.37½@1.50	.40@.50
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.60@1.75	1.15@1.25	1.50	1.62½	.40@.87½
San Francisco	1.37½	1.12½	1.12½	.87½	1.12½	1.37½	.68¾
Seattle	1.50	1.12½	1.12½@1.25	1.00	1.12½	1.25	.70

*Minimum rates are for construction other than buildings, non-union.


Atlanta
St. Louis
Boston
CEMENT
Without Charge for 4 Bags Delivered by Truck to Job
(Engineering News-Record Statistics)
Dollars per Barrel
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930


CEMENT SHIPMENTS
From Mills to Contractors and Dealers
Bureau of Mines
Millions of Barrels
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930


CEMENT IMPORTS AND EXPORTS
Bureau of Foreign and Domestic Commerce
Imports
Exports
Thousands of Barrels
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

CEMENT PRICES, SHIPMENTS AND FOREIGN TRADE

ports has been down for a year and a half. Average delivered prices are: $14.58; month ago, $14.63; year ago, $15.12.

Cement—Demand dropped 13 per cent (to 4,955,000 bbl.) in January, with production at 38 per cent, compared with 46 a year ago. Mill prices average $1.79, compared with $1.73 a month ago and $1.80 a year ago. Many price rises are reported in the Mid-West, but none on either coast—with cement continuing on the free list.

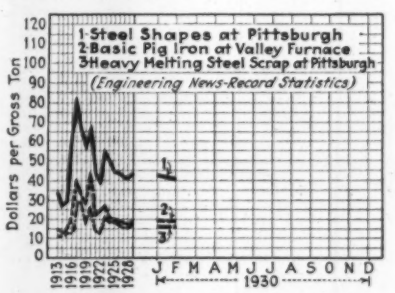
Steel—Operation is at 80 per cent, compared with 81 the week before. A year ago the figure was 90, and rising each week to the peak of 100 touched at the end of April. Price of beams is $1.80, same as last month; $1.90 a year ago. Will operations continue around 80, or go higher? An item worth watching is the scrap market, which in December and January was active with rising prices and now is flat.

Lumber—Despite bad weather in the Southern pine regions and on the Coast, cutting is at 219,000,000 ft. per week, or 7 per cent above a year ago. Mill stocks are 11 per cent heavier; unfilled orders 17 smaller. Average delivered prices of 3x12 pine are: $66.74; month ago, $66.74; year ago, $60.44. For fir timbers: $51.30; $51.06; and $47.68. The weakest species are North Carolina pine, California redwood, and Northern hemlock and hardwood.

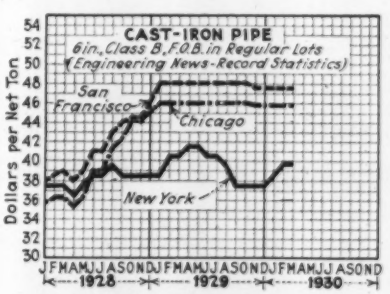
Cast-Iron Pipe—Seasonal buying in December and January raised cast-iron pipe prices $2 and $1 respectively at Burlington (N. J.) mill. Though the base price for 6-in. Class B remains $37, buying is light. No change in foundry grades of iron last month.

Road Oils—Lively demand for road oils in the West and South raised prices and increased purchasing generally. Meanwhile, production has fallen slightly.

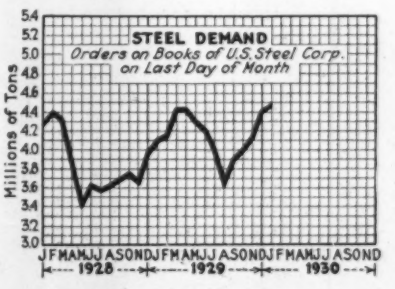
Lime—Prices of Southern and Western lime have developed appreciable firmness during the last month. Common lump is up 10c. per barrel, to $2.50 at Kansas City; hydrated common advanced 50c. per ton, to $15.50, in Atlanta.


1-Steel Shapes at Pittsburgh
2-Basic Pig Iron at Valley Furnace
3-Heavy Melting Steel Scrap at Pittsburgh
(Engineering News-Record Statistics)
Dollars per Gross Ton
1913 1916 1919 1922 1925 1928
J F M A M J J A S O N D
1930

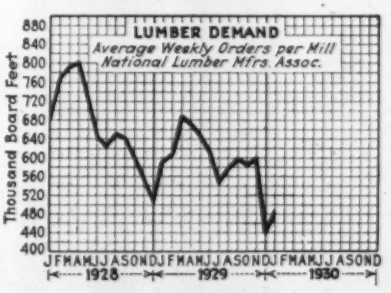
STEEL AND IRON PRICES


CAST-IRON PIPE
6 in., Class B, F.O.B. in Regular Lots
(Engineering News-Record Statistics)
San Francisco
Chicago
New York
Dollars per Net Ton
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

CAST-IRON PIPE PRICES


STEEL DEMAND
Orders on Books of U.S. Steel Corp. on Last Day of Month
Millions of Tons
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

STEEL CONSUMPTION


LUMBER DEMAND
Average Weekly Orders per Mill
National Lumber Mfrs. Assoc.
Thousand Board Feet
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1928
1929
1930

LUMBER CONSUMPTION

Public Financing in February

State and municipal bond issues in January and February totaled 10 per cent more than for the two months of 1929, but were second lowest since 1923. The February total was below normal, and the outlook is for a limited supply this month. Following are figures for four years:

	February	Two Months
1930	$ 74,270,000	$178,121,000
1929	88,753,000	162,104,000
1928	132,725,000	235,863,000
1927	72,681,000	247,357,000

February authorizations by 76 municipalities totaled $17,773,000, the largest since 1926, according to the *Daily Bond Buyer*. A few were: $6,230,000, Tulsa; $4,000,000, Birmingham; $850,000, High Point, N. C.; $690,000, Clayton county, Iowa.

Rejections by seventeen states and 33 municipalities totaled $7,862,000, compared with $5,122,000 a year ago and $6,952,000 in February, 1928.

New Corporation Capital in January

New capital issues have been increasing in volume since the record low mark of November. Corporate issues of December, exclusive of foreign, refunding and non-productive paper, totaled 240 millions. The January total is 544 millions. The items for the two months compare as follows:

	Thousands of Dollars	
	December	January
Railroads	57,283	7,395
Public utilities	144,287	472,872
Metals and coal	1,500	24,502
Motors and accessories	540	1,593
Other manufacturing	18,857	7,995
Oil	4,575	2,275
Land, buildings	12,683	27,818
Total	239,725	544,450

Public utilities except railroads accounted for 39 per cent of all net issues of 1929, for 60 per cent of the December figure and 87 per cent of the January figures. The tendency to make bonds and preferred stock more attractive continues. Among the more conspicuous of January issues which contain convertible features or carry subscription rights or warrants are the following: $60,000,000 Insull Utility Instruments 6s, 1940; $30,000,000 Associated Gas & Electric 5s, 1950; $10,000,000 Northwestern Power 6s, 1960.

Financing for investment trusts and holding and trading companies, not included in the above table, aggregated only 63 millions in January, compared with 277 in January, 1929. For the whole of 1929 this item totaled 2,222 millions, or 45 per cent of financing exclusive of refunding.

Several of the January issues which represent capital investment are listed below:

Long Term Bonds	**Purpose**	**By**
$2,115,000	Equipment,	C.,M.,&St.P.&P.
5,280,000	Equipment,	N.Y.C.R.R.
150,000,000	Betterments,	A.T.&T.
50,000,000	Improvements,	Int.T.&T.
800,000	Capital exp.,	Jamaica (N. Y.) Water Supply Co.
20,000,000	Additions,	Pub.Serv.El.&Gas
Short Term Bonds		
$3,000,000	New plant,	Newton Steel Co.
Stocks		
$87,500,000	Capital exp.,	Pac.T.&T.
2,000,000	Capital exp.,	Safeway Stores.

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per barrel, *without charge for bags*, cash discount not deducted. Prices marked f.o.b. are manufacturers'; others are delivered by truck to contractors:

	Mar. 6, 1930	One Month Ago	One Year Ago
Atlanta	**$2.60**	$2.35	$2.25
Baltimore	2.40	2.40	2.65
Birmingham	2.40	2.40	2.60
Boston	2.65	2.65	2.25@2.40
Cedar Rapids (f. o. b.)	**2.23**	2.04	2.24
Chicago (f. o. b.)	**1.95**	1.85	2.05
Cincinnati (f. o. b.)	**2.14**	1.92	2.22
Cleveland (f. o. b.)	**2.04**	1.94	2.24
Dallas	2.15	2.15	2.15
Davenport (f. o. b.)	**2.14**	2.04	2.24
Denver	2.61	2.61	2.55
Detroit (f. o. b.)	1.95	1.95	1.95
Duluth (f. o. b.)	**2.04**	1.94	2.04
Indianapolis, (f. o. b.)	**1.99**	1.89	2.09
Jersey City	2.60	2.60	2.25
Kansas City, Mo	2.65	2.65	2.20
Los Angeles	1.92	2.42	2.66
Milwaukee (f. o. b.)	**2.10**	2.00	2.20
Minneapolis (f. o. b.)	**2.27**	2.02	2.22
Montreal (f. o. b.)	2.05	2.05	1.70
New Orleans	2.65	2.65	2.65
New York	2.30	2.30	2.25
Peoria (f. o. b.)	**2.12**	2.02	2.22
Philadelphia	2.10	2.10	2.40
Pittsburgh (f. o. b.)	**1.95**	1.85	2.05
St. Louis	2.10	2.10	2.45
St. Paul (f. o. b.)	**2.27**	2.02	2.22
San Francisco	2.54	2.54	2.41
Seattle	2.70	2.70	2.70
Toledo (f. o. b.)	**2.20**	2.03	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich	$1.65	Limedale, Ind	**$1.70**
Buffington, Ind	**1.70**	Mason City, Ia	1.85
Hannibal, Mo	1.80	Norfolk, Va	1.90
Houston, Tex	1.95	North Birmingham, Ala	1.70
Hudson, N. Y	1.85	Richard City, Tenn	2.05
Ironton, Ohio	**1.75**	Steelton, Minn	1.85
Iola, Kan	1.85	Universal, Pa	**1.70**
La Salle, Ill	1.70	Wyandotte, Mich	1.70
Lehigh Valley District	1.75		

SAND AND GRAVEL—Per cu.yd., delivered by dealers. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd., unless otherwise specified in pounds:

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	$3.00	$3.00	$2.25
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600 lb. per cu.yd.)	3.00	3.00	2.65
Boston, per ton	1.90	1.90	1.25
Chicago	1.90	1.90	1.80
Cincinnati, per ton	1.65	1.65	**2.25**
Cleveland (3,000 lb.) (2,700 lb.)	2.60	2.60	2.50
Dallas	2.60	2.60	2.60
Denver (2,700 lb. per cu.yd.)	1.80	1.80	1.30
Detroit (2,600 lb. per cu.yd.)	3.25	3.25	2.75
Kansas City, Mo	.....	.....	.....
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800 lb.) (3,000 lb.)	2.40	2.40	1.10
Montreal, per ton	1.25	1.25	1.25
New Orleans (2,700 lb.) (2,500 lb.)	3.75	3.75	2.75
New York	3.40	3.40	2.15
Philadelphia, per ton	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh, per ton	2.20	2.20	2.40
St. Louis, per ton	2.35	2.25	2.00
San Francisco, per ton	1.75	1.75	1.75
Seattle (3,200 lb.) (2,850 lb.)	1.75	1.75	1.75

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Per cu.yd., delivered by dealers. Weight, 1½ tons per cu. yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	$2.65	$2.65
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	3.00	3.25
Boston, per ton	2.10	2.10
Chicago, Limestone (2,500 lb. per cu.yd.)	1.90	1.90
Cincinnati, per ton	2.25	2.25
Cleveland, per ton (2,500 lb. per cu.yd.)	2.70	2.70
Dallas (2,500 lb. per cu.yd.)	3.25	3.40
Denver, Granite (2,700 lb. per cu.yd.)	2.50	2.50
Detroit, Limestone, per ton (2,500 lb. per cu.yd.)	3.00	3.00
Kansas City, Limestone	.....	.....
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone (2,600 lb. per cu.yd.)	2.40	2.40
Montreal, per ton	1.90	2.10
New York, Limestone	3.40	3.40
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh, per ton	2.75	2.75
St. Louis, per ton, (2,400 lb. per cu.yd.)	1.90	1.90
San Francisco, Trap rock, per ton	1.6	1.65
Seattle, (2,700 lb. per cu.yd.)	1.90	1.90

CRUSHED SLAG—Manufacturers' quotations on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.35	1.35	.....	.80
Eastern Pa. and Northern N. J	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25
Western Pennsylvania	.....	.....	.....	.....
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Building tile per block, delivered by dealers to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.072	$0.099	$0.135	$0.181	$0.202
Baltimore	.105	.....	.20	.....	.26
Birmingham	.09	.127	.174	.218	.261
Boston	.086	.113	.155	.20	.26
Chicago	.076	.104	.142	.182	.202
Cincinnati	.066	.09	.125	.16	.18
Cleveland	.064	.088	.128	.171	.19
Dallas	*.092*	*.118*	*.175*	**.284**	.296
Denver	.0975	.135	.175	.2125	.25
Detroit	.098	.135	.184	.24	.265
Kansas City	.0525	.077	.184	.24	.265
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	.0611	.081	.10605	.1302	.1737
Montreal	.12*	.....	.22†	.....	.....
New Orleans	.086	.118	.16	.212	.256
New York	.0864	.1296	.162	.....	.....
Perth Amboy, N.J. (f.o.b.)	.....	.....	.....	.2388	.2956
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.068	.....	.1175	.....	.1726
St. Louis	.078	.104	.145	.175	.21
San Francisco	.108	.156	.255	.....	.....
Seattle	.085	.115	.18	.....	.....

*4x4x12. †8x8x12.

BRICK—Prices delivered by dealers per thousand, are as follows:

	Common	Paving 3x8½x4-in.	F.O.B. 3½x8½x4-in
Atlanta	$14.50	$36.00*	$42.00†
Baltimore	13.00	40.00	46.00
Birmingham	15.00	*26.00**	*31.00†*
Boston	16.00	43.00	47.00
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	33.00	36.00
Dallas	13.50	29.50*	.....
Denver	11.00	.....	.....
Detroit	15.00	33.50	36.50
Kansas City	14.00	.....	.....
Los Angeles	12.00	.....	.....
Minneapolis	12.75	.....	.....
Montreal	20.00	.....	.....
New Orleans	16.50	38.00*	45.00
New York	14.00	45.00	50.00
Philadelphia	16.00	40.00	46.00
Pittsburgh	16.00	40.50	45.00
St. Louis	*13.00*	38.00	40.00
San Francisco	14.50	45.00*	.....
Seattle	14.00	50.00	55.00

*2½x8½x4 in. †3x8½x4.

LIME—Prices delivered by dealers to job:

	Hydrated, per Ton— Finishing	Common	Lump, per Barrel— Finishing	Common
Atlanta	$21.00	**$15.50**	.....	.....
Baltimore	22.00	14.00	$2.55†	.....
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	22.00	15.00	4.00*	3.00*
Chicago	18.00	14.00	18.00‡	1.35†
Cincinnati	15.30	12.70	.....	.....
Cleveland	16.00	12.00	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	16.00	12.50	2.75†	**2.50†**
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	19.75	.....	.....	15.00‡
New Orleans	.....	.....	2.60†	1.60†
New York	21.00	14.00	4.10*	3.15*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	21.00	19.00	2.50†	.....
St. Louis	24.00	18.00	2.75†	15.00‡
San Francisco	27.50	20.00	2.00†	1.60†
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	*$0.18*@$0.20	Minneapolis	$0.15
Brooklyn and Queens	.12@.14	New Orleans	.22
Cleveland	.16@.17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Roofing, f.o.b., quarry, Bangor, Pa., net, per square:

No. 1 Clear	$9.45@$13.05
No. 1 Ribbon	8.10@ 9.23
Medium Clear	8.55@ 10.13

Road and Paving Materials

PAVING STONE—Carloads or cargo lots of granite blocks, 4x8x4-in., dressed, f.o.b:

Atlanta	$3.00 per sq.yd
Baltimore	3.00 per sq.yd.
Boston	135.00 per M.
Chicago, 5 in	3.25@3.90 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M
Detroit, 5 in	3.00 per sq.yd.
Kansas City	3.00 per sq.yd.
Minneapolis, 4½x8x5 in	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd	150.00 per M.
Philadelphia	125.00 per M.
St. Louis, 4x5x8 to 12 in	3.50 per sq.yd

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Prices, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	2.25
Chicago	3½	12	2.10
Cincinnati	3½	16	2.35
Dallas	3½	18	3.90
Kansas City	3½	16	2.75
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.40
New York	3½	16	2.70
St. Louis	3½	16	2.25

FLAGGING—Alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—*New York*: Bluestone, f.o.b. barge, 5x16 in., rough, 90c. per lin. ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16 in., f.o.b., $1.00 per lin.ft.; roundings, $1.50 per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls. or 425-lb. drums); also in tank-car lots, f.o.b. points listed:

	Package	Tank-cars
Atlanta (Mexican)	$20.40	$16.40
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	23.00
Boston (Mexican)	23.50	18.00
Chicago (Texas)	23.50	19.30
Cincinnati (Kentucky Rock)		12.30
Cleveland	24.00	20.00
Dallas (Texas)	24.85	
Denver (California)	35.00	
Detroit (Mexican)	19.72	15.69
Kansas City, Mo. (Texas)	35.00	28.00
Los Angeles ("D" Grade, Calif., f.o.b., El Segundo)	18.00	12.00
Maurer, N. J. (Bermudes)	30.00	
Maurer, N. J. (Trinidad)	25.00	
Minneapolis, (Stanolind, f.o.b., Twin Cities)	23.00	19.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	24.00	21.00
New York (Texas)	22.50	18.50
Philadelphia (Mexican)	18.00	15.00
Pittsburgh (Standard Oil)	24@26	14@18
St. Louis (Mexican)	22.40	18.40
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, Calif., f.o.b. Richmond)	18.00	12.00

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0525
Dallas, 40@50% asphalt	.06
Dallas, 50@60% asphalt	.06
New York, 40@50% asphalt (at terminal)	.05
New York, 50@60% asphalt (at terminal)	.05
St. Louis, 40@50% asphalt	.045
St. Louis, 50@60% asphalt	045

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	$15.00
Pittsburgh, basic, incl. freight ($1.76) from Valley	20.26

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.15	$2.15
Chicago, warehouse, delivered	3.10	3.10
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	4.50	4.50
New York, warehouse, delivered, up to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b.	1.80	1.80
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.40	3.40

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ½-in.:

Birmingham, large mill lots, f.o.b.	$2.15
Chicago, warehouse, delivered	2.15@3.00
Cleveland, warehouse, delivered	2.25@2.44
Dallas, warehouse, delivered	3.65
New York, warehouse, delivered, over 5 tons	2.70
Pittsburgh, large mill lots, stock lengths, f.o.b.	2.00
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Per 100 sq.yd., painted, delivered to job, in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$18.50	$22.00	$20.50	$20.50	$21.50	$21.50
2.5	19.50	23.00	21.50	21.50	24.00	22.50
3.0	21.00	25.00	23.00	23.00	26.00	25.00
3.4	22.00	26.50	24.00	24.00	30.00	27.00

WIRE REINFORCEMENT FOR CONCRETE—Manufacturers' quotations per 100 sq.ft. in carloads at mills; and delivered by dealers, in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse Delivery: New York	St. Louis	Dallas	San Francisco
032	22	$0.99	$1.01	$1.39	$1.45	$1.13	$1.22
049	28	1.26	1.29	1.76	1.80	1.38	1.55
068	35	1.54	1.58	2.18	2.25	1.67	1.91
093	40	1.98	2.03	2.79	2.95	2.00	2.46
126	57	2.45	2.51	3.45	3.55	2.55	3.03
153	68	2.92	2.99	4.13	4.25	3.15	....
180	78	3.35	3.43	4.73	4.85	3.47	....

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb., base:

	Blue Annealed No. 10 *	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35	$4.05	$4.60
Cleveland, warehouse, delivered	3.30	3.75	4.50
New York, warehouse, delivered	3.90†	3.90	4.50
Pittsburgh, large mill lots, f.o.b.	2.10	2.55@2.75	3.30
St. Louis, warehouse, delivered	3.45	4.25	4.85
San Francisco, warehouse, delivered	4.00	4.70	5.10

*Light plates †Up to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York, and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
"Special Steel" and extra strong cast steel, round strand rope	27½%

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round-head, ½-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	$4.00
Dallas, warehouse, delivered	5.50
New York, warehouse, delivered	4.50*
Pittsburgh, large mill lots, f.o.b.	3.10
St. Louis, warehouse, delivered	4.15
San Francisco, warehouse, delivered	5.00
Seattle, warehouse, delivered	4.25

*This price is for full kegs; broken kegs are $6.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	$10.70

SHIP SPIKES—Per 100 lb., black, from dealers' warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.55	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Per 100 lb. keg, base, delivered from warehouse stocks; also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.30@$2.40	$3.30	$2.75	$2.95	$3.75	$3.25	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$11.50@$12.50	$13.00@$13.50	$12.50@$13.00
Stove plate	8.00@9.00	11.00@11.50	10.00
No. 1 machinery cast	10.85	14.00@14.50	12.00*
Machine shop turnings	7.00@7.50	7.00@7.50	8.25
Cast borings	7.00@7.50	10.00@10.50	9.50
Railroad malleable	12.50@13.00	16.50@17.00	13.00
Re-rolling rails	10.50@11.00	15.00@15.50	13.00
Re-laying rails, 56@60 lb.	23.00@24.00	20.00@24.00	
Heavy melting steel, No. 1	10.50@11.35	13.50@14.00	12.25
Iron and steel pipe	9.25@9.75	9.00@9.50	9.50@10.00

*Net ton.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant-steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71†
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15*		

*Minimum weight on structurals, 60,000 lb. †Except iron or steel pipe and fittings.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard openhearth rails	$43.00	$43.00	$43.00
Light rails, 25 to 45 lb.	36.00	34@36	34@36
Re-rolled rails	34.00	34@36	34@36

RAILWAY TIES—For fair-sized orders, f.o.b., the following prices hold:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application.		
Birmingham	White oak, creosoted	1.52	1.75
	Southern pine, creosoted	1.25	1.60
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	1.25	1.60
	Red oak, creosoted	1.65	2.00
San Francisco	Sap pine or cypress, untreated	1.00	1.35
	Douglas fir, green, untreated	87½	1.21
	Douglas fir, empty cell, creosoted	1.60	2.10
Montreal	Birch or maple, untreated	.75@1.25	.75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb. f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ⅝-in. and larger	$2.80	$3.55	$3.45	$3.65@$3.75	$4.35
Track bolts	3.80@4.00	4.55	5.85	4.65@4.85	5.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.75	.....	.....

Tie plates: Price at Pittsburgh mill, $2.07½ per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		3½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	55.5%	42.5%	51.6%	39.0%
Cleveland, warehouse, delivered	55.5%	43.5%	53.5%	40.5%
New York, warehouse, delivered	53.74%	41.2%	50.32%	37.78%
Pittsburgh, large mill lots, f.o.b.	62%	50.5%	59%	47.5%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Prices of U. S. Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$40.00@$41.00	$37.00@$38.00
Burlington (N. J.) mill	40.00	37.00
Chicago	48.20@49.20	45.20@46.20
New York	42.60	39.60
Pittsburgh	48.50@49.50	45.50@46.50
St. Louis	45.60@46.60	42.60@43.60
San Francisco	50.00@51.00	47.00@48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Prices delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.135	$0.225	$0.75	....	.....	.....	.....
Baltimore	...	.30	.58	....	$1.93	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.185	.30	.555	1.35	2.25	3.70	6.50
Chicago	.15	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	.135	.21	.405	1.25	2.025	3.67	5.74
Cleveland	.18	.294	.567	1.35	2.43	4.824	7.38
Dallas	.25	*.375*	*.68*	*1.60*	*2.85*	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	.21	.29	.52	....	1.90	3.80	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.85	3.49	4.97
Montreal	.36	.53	.78	1.45	2.75	4.20	.....
New Orleans	.195	.325	.585	1.10	2.11	.....	.....
New York	.185	.29	.56	1.35	2.45	4.60	7.07
Philadelphia	.117	.182	.351	1.05	1.89	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.85	1.53	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.1925	.275	.495	1.155	1.98	3.30	4.95
Seattle	.22	.30	.54	1.26	2.16	3.50	.....

CLAY DRAIN TILE—Prices delivered by dealers, per 1,000 lin.ft.:

Size, In.	New York	Birm'ham	St. Louis	Dallas	San Fran.	Seattle
4	$55.00	$56.00	$50.00	$63.00	$67.50	$60.00
6	112.00	112.00	85.00	100.00	112.50	112.00

Miscellaneous

LINSEED OIL—Raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:

New York....$0.148 Chicago....$0.154 Minneapolis.. **$0.159**

WHITE AND RED LEAD—Base price per 100-lb. keg, f.o.b., New York: White, dry, $13.75; White, in oil, $14.25; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water, sewage treatment, road work, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb	5.50@ 6.00
Soda ash, 58%, in bags, per 100 lb	1.32@ 1.35
Chlorine, cylinders, per lb	.04½@ .06
Bleaching powder, in drums, f.o.b. works, per 100 lb	2.00@ 2.10
Calcium chloride, in drums, f.o.b. works, per ton	22.50

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ¼-in., 7-ft.; 6-in.; ⅜-in., 6-ft., 1-in.; ½-in., 4-ft., 5-in.; 1-in., 3-ft., 8-in.; 1¼-in., 2-ft., 5-in.; 1½-in., 1-ft., 8-in. Following prices are quoted by dealers per pound for ¼-in. and larger:

Atlanta	$0.25	Kansas City	$0.25
Baltimore	.225	Los Angeles	.25
Birmingham	.26	Minneapolis	.23
Boston	.215	Montreal	.26
Chicago	.22	New Orleans	.25
Cincinnati	.21	New York	.21
Cleveland	.21	Philadelphia	.23
Dallas	.20	San Francisco	.205
Denver	.24	Seattle	.215
Detroit	.23	St. Louis	.215

BUILDING PAPER—Black, in carloads, per roll of 500 sq.ft., f.o.b., producing point $2.09

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.91

ROOFING MATERIALS—Prices f.o.b., New York, delivered by dealers to contractors in carloads:

Asphalt felt, per 100 lb	$2.60
Tar felt, per 100 lb	2.60
Asphalt coating, per gal	.34½
Tar pitch, in 350 lb. barrels, per ton	28.00

PREPARED ROOFINGS—Prices delivered by dealers to contractors, in carloads, f.o.b. New York, per square:

Single shingles, slate finish, sufficient to cover 100 sq.ft	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:

AA .....83% A .....86% B 88%

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	.2225	.2450
Birmingham	.22	.245	Montreal	.20	.24
Boston	.22	.25	New Orleans	.195	.22
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	.1875	.225	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	.155	.18
Kansas City, Mo.	.2025	.2225	Seattle	.1525	.175

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

New York—Timbers, rough, delivered to contractor at site of job, in 20 ft. lengths and under, per M. ft., b.m.:

	Merchantable Long-leaf Yellow Pine	No. 1 Common Douglas Fir
3x4 to 8x8	$55.00	$39.00
3x10 to 10x10	65.00	**40.00**
3x12 to 12x12	75.00	**42.00**
3x14 to 14x14	87.50	**50.00**

Chicago—Prices, f.o.b., in carloads, No. 1 Common, rough, per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft., b.m:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	$43.00	$42.00
3x10 to 10x10	50.50	42.00
3x12 to 12x12	62.50	42.00
3x14 to 14x14	74.50	43.00

San Francisco—Douglas fir, No. 1 common, rough, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft., b.m:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$33.00	$36.00
3x6 and 8	33.00	36.00
3x10 and 12	33.00	36.00
3x14	37.00	39.00

Other Cities—Delivered by dealers, No. 1 Common, rough, per M. ft., b.m:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	$55.00	.....	.....	.....	$65.00	.....
Baltimore	36.00	$50.00	$53.50	$61.00	75.00	$50.25
Birmingham	53.00	.....	.....	.....	80.00	.....
Boston	52.00	47.00	47.00	48.00	60.00	50.00
Cincinnati	52.50	62.50	.....	.....	70.00	57.50
Cleveland	63.00	63.00	.....	.....	63.00	63.00
Dallas	**55.00**	57.50	55.00	55.00	65.00	**55.00**
Denver	.....	**58.00**	**58.00**	**56.00**	.....	58.00
Detroit	55.00	53.00	.....	.....	68.50	53.00
Kansas City, Mo.	60.00	60.00	.....	.....	67.00	67.00
Los Angeles	.....	42.50	.....	.....	.....	44.50
Minneapolis	58.00	52.25	38.25‡	.....	58@60	52.25@53.75
Montreal	.....	.....	.....	.....	56.00	48.00
New Orleans	52.00	48.00	.....	44.00	76.00	72.00
Philadelphia	50.00	43.00	42.00	48.00	60.00	43.00
Pittsburgh	65.00	70.00	75.00	65.00	65.00	65@72
St. Louis	45.00	39.00	38.00	.....	57.50	39.00
Seattle	.....	22.00	.....	.....	.....	21.00

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	$42.50	.....
Baltimore	56.00	$45.00	*$44.00*	.....	.....
Birmingham	36.00	.....	.....	45.00	.....
Boston	**46.00**	42.00	42.00	**48.50**	$46.00
Cincinnati	65.00	57.50	.....	42.00	55.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	60.00	.....	.....	.....	.....
Denver	.....	**47.00**	*45.00*	.....	*51.00*
Detroit	47.50	45.00	.....	48.50	47.00
Kansas City, Mo.	56.00	56.00	.....	49.00	49.00
Los Angeles	.....	41.50	.....	.....	55.00
Minneapolis	53.00	46.00	39.75‡	51.00	45.00
Montreal	56.00	.....	.....	.....	.....
New Orleans	49.00	49.00	.....	59.00	55.00
Philadelphia	52.00	43.00	41.00	55.00	44.00
Pittsburgh	50.00	60.00	59.00	42.00	.....
St. Louis	41.00	39.00	38.00	42.00	39.00
Seattle	.....	*18.00*	.....	.....	*20.50*

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

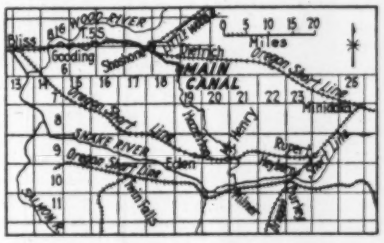
PILES—Prices of Nichols Bros., 90 West St., N.Y.C., per lineal foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.33	.41
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.38	.41

Unit Prices From Current Construction Bids

Irrigation Canal and Structures in Idaho

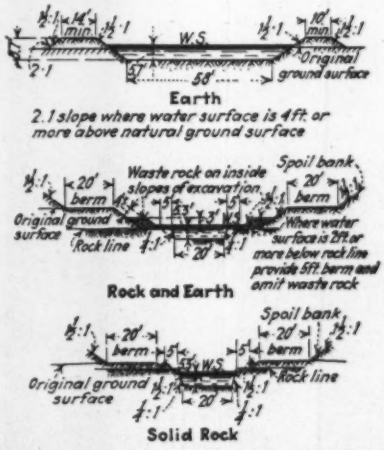
Bids were opened Dec. 27, 1929, by the Bureau of Reclamation for about 16 miles of the main canal for the Gravity Extension division, Minidoka (federal) irrigation project in Idaho. The entire canal, to divert water from Snake River at Milner dam, 25 miles east of Twin Falls, Idaho, is to run 70 miles to a constructed canal serving lands in the vicinity of Gooding, Idaho, as shown on the location map. The latter canal is part of a gravity system constructed under the Carey act twenty years ago, now operated by the Big Wood Canal Co. The first 3½ miles of the new canal is to have a capacity of 2,750 sec.-ft., and will be in a deep cut, largely rock; much of the remaining 64 miles is in rock country with capacities decreasing from 1,600 to 400 sec.-ft. The last 3 miles pass through a basaltic region without soil, where a concrete flume, 11x7 ft., will be required.



LOCATION MAP
Squares are townships (6 miles square)

Government Furnishes Materials—Government will furnish (f.o.b. nearest railway station) cement, steel reinforcing, lumber except for forms, and other materials that will become a part of the completed construction. Contractor furnishes all form material, sand and gravel for concrete, rock for dry-rock paving, backfill, water and all other materials not a part of the completed structures.

Class 1 excavation is (*a*) material that can be plowed to a depth of 6 in. or more by a six-horse or six-mule team handled by four men, (*b*) material that can be handled by scrapers or excavated without blasting, (*c*) excavated by power shovels or dragline excavators having dippers or buckets of at least ¾- and 1-cu.yd. capacity and (*d*) all boulders not exceeding 2 cu.ft. Class 3 is solid rock in place and large boulders. Class 2 is other material, including hardpan, cemented gravel and soft rock, and boulders of 2 cu.ft. to ½ cu.yd.

The drawings show typical canal sections. Embankments may be built by teams and scrapers or dump wagons or by excavating machinery depositing material directly from work, but materials must be placed in layers not exceeding 12 in. thick and the top leveled. No additional allowance above prices bid will be made on account of materials being wet or frozen.

W.S.
Original ground surface
Earth
2:1 slope where water surface is 4 ft. or more above natural ground surface
Waste rock on inside slopes of excavation
Spoil bank
berm
Where water surface is 2ft. or more below rock line provide 5ft. berm and omit waste rock
Rock line
Rock and Earth
Solid Rock

TYPICAL CANAL CROSS-SECTIONS

Structures to be erected at various points include a check and wasteway, metal flumework, a concrete siphon, concrete box and pipe culverts, a number of timber highway bridges, and a rock-paved drainage inlet.

Unit bids were asked on five schedules. Most of the items appear in all the schedules, quantities differing. Estimates were submitted by four contractors and cover 108 items: (A) Haas, Doughty & Jones, San Francisco, (awarded contract); (B) Utah Construction Co., Ogden; (C) John Phillips Co., San Francisco; (D) Morrison-Knudsen, Boise. Bids were extremely close, both on schedules and on the entire project. Between low and second the difference was 1½ per cent for the total bid; between second and third, 2½; between third and fourth, 6; between low and high, 9½; between low and average, 3 per cent. In view of the similarity of operations on all schedules the items have been combined and average bids are given in the accompanying tabulation.

In future unit prices will appear in this position instead of at the end of the Construction News section. They will continue the former series. Such text information and drawings as necessary for due understanding of the figures bid will accompany the tables. Generally the prices of the two or three lowest bids only will be given.

Readers are invited to contribute bid figures and information.

The contractor is required to begin work within 60 days after receipt of notice to proceed, and complete within 440 days. There is a penalty of $100 a day for each of the schedules for each day's delay in completing the work.

	A	B	C	D
713,000 cu.yd. excav. canal class 1	$0.122	$0.131	$0.13½	$0.11
78,000 cu.yd excav. canal class 2	.341	.301	.25	.302
250,500 cu.yd. excav. canal class 3	1.290	1.310	1.35	1.60
895,000 sta.yd. overhaul	.032	.04	.04	.035
2,330 cu.yd. excav. structures class 1	.60	.60	.70	.512
640 cu.yd. excav. structures class 2	1.10	1.00	1.50	1.031
1,520 cu.yd. excav. structures class 3	4.00	3.00	3.00	3.00
1,025 cu.yd. excav. embank. cut-off trenches, class 3	4.00	3.00	3.00	4.00
3,560 cu.yd. backfill structures	.50	.60	.75	.26
1,290 cu.yd. puddling backfill	.50	.40	1.25	.415
990 cu.yd. dry-rock paving	6.00	3.50	2.50	2.343
893 cu.yd. concrete	23.247	22.00	28.75	22.00
66,600 lb. placing reinforcing	.03	.03	.03	.03
158 M. ft. b.m. erecting timber bridges	25.00	25.00	30.00	30.00
48 M ft. b.m. erecting treated timber bridges	30.00	35.00	35.00	40.00
20 M ft. b.m. erecting timber in flumes	35.00	35.00	45.00	40.00
176 lin.ft. laying 21-in. corr. metal pipe	1.00	.90	.50	.50
16 lin.ft. laying 24-in. corr. metal pipe	1.00	.75	.50	.50
72 lin.ft. laying 18-in. conc. pipe	1.50	1.75	1.00	.75
1,728 lin.ft. laying 24-in. conc. pipe	2.00	2.25	1.50	1.00
568 lin.ft. laying 30-in. conc. pipe	2.50	2.80	1.75	1.116
496 lin.ft. laying 36-in. conc. pipe	3.00	3.40	1.75	2.00
1,092 lin.ft. erecting No. 48 metal flume	.50	2.50	1.25	.50
81 lin.ft. erecting No. 60 metal flume	1.00	3.50	1.25	.50
40 lin.ft. erecting No. 84 metal flume	1.00	4.25	1.25	1.00
15,400 lb. installing and painting struc. steel	.061	.05	.07	.08
16,755 lb. installing and painting gates	.087	.07	.05	.08
388 sq.yd. laying bituminous wearing surface on bridge floors	1.50	.80	1.50	1.50
1,550 cu.yd. surfacing bridge approaches	4.112	3.50	3.50	4.00
800 cu.yd. surfacing state bridge approaches	4.50	3.50	4.00	4.00
	$537,200	$546,212	$558,966	$594,987

Vitrified Clay Sewers for Robbinsdale, Minn.

A contract was recently awarded by C. F. Wilkins, manager, village of Robbinsdale, Minn., for 13 miles of vitrified clay sewers to O'Neill & Preston, St. Paul, for $220,000. The engineer's estimate was $258,040. Thirteen bids were submitted, averaging $281,000, with the low 20 per cent under this figure. The bids were on 10-in. and 8-in. pipe. Excluding the highest two bids, which were rather out of line with the others, being respectively 46 and 24 per cent above the average total bid, the average bid prices for lengths of 8 to 18 ft. were as follows:

8 to 10 ft.	$1.21
10 to 12 ft.	1.39
12 to 14 ft.	1.71
14 to 16 ft.	2.24
16 to 18 ft.	3.06

The 8-in. pipe averaged about 20c. a foot less than the 10-in., the price for 8- to 10-ft. lengths being $1.10 per foot and for 16- to 18-ft. $2.82.

Unit Prices From Current Construction Bids

Two Earth Dams Near Fort Worth, Tex.

Two large earth dams for the Tarrant County (Tex.) Water Control and Improvement District No. 1, supplying Fort Worth, were placed under contract late in January. These dams, Bridgeport and Eagle Mountain, are designed for both water supply and flood control. They are 110 ft. and 80 ft. high respectively, with concrete spillways equipped with Phillip & Davis caterpillar gates 35 ft. and 30 ft. high.

Streamflow during construction is to be passed by twin 14-ft. tunnels. After completion of the dam, 48-in. gate valves in these construction tunnels will control water released from Bridgeport Lake to Eagle Mountain Lake to Fort Worth.

Both sites are on the West Fork of Trinity River. The Bridgeport dam is 5 miles northwest of the town of that name, which is the nearest rail point. The Eagle Mountain is 12 miles northwest of Fort Worth, with nearest rail point 6 miles, at Saginaw. Competitive prices on practically all materials were obtainable at Fort Worth.

At Bridgeport, either of two methods was permitted for placing earth: (1) wetted and rolled embankment; (2) puddled core with wetted and rolled layers (accepted). At Eagle Mountain a third method was permitted, hydraulic fill (accepted). A core trench will be excavated at each site.

Six bids were received for Bridgeport, low being $1,350,493, or 11 per cent below average. For Eagle Mountain the low was $2,331,227, or 9 per cent below average. The low bidder on the former project offered no bid on Eagle Mountain, and the low bidder on the latter was awarded both contracts. This bidder is a combine comprising Trinity Farms Construction Co., which will do clearing and dirt work, and McKenzie and Uvalde Construction companies, which will do concrete work, piling, riprapping and roads. Total contract price is $3,758,216, and time to complete is 700 working days. Hawley & Freese, Fort Worth, are consulting engineers. Complete unit prices are given for Eagle Mountain. Bidders are: (A) Trinity Farms Construction Co.; (B) W. E. Callahan; (C) Arundel Corp.; (D) Seybold & Mitchel.

	A	B	C	D
484,000 cu.yd. wetted and rolled embankment	$0.322	$0.38	$0.45	$0.45
2,360,000 cu.yd. wetted and rolled embankment (main dam)	....	.405	....	.44
150,000 cu.yd. core trench excav.	.20	.28	.45	1.00
2,360,000 cu.yd. hydraulic fill embankment	.361	.45	.42	....
2,360,000 cu.yd. puddled core, wetted and rolled embankment	....	.45	....	.46
10,000 cu.yd. dragline (or team) embankment	.20	.40	.29	.30
56,200 cu.yd. riprap paving	4.30	3.50	3.95	4.25
22,000 cu.yd. gravel blanket	....	5.00	....	4.30
22,000 cu.yd. crushed stone blanket	2.70	3.50	2.20	3.50
30 acres Bermuda grass sodding	250.00	300.00	220.00	150.00
5,200 cu.yd. gravel roadway	2.85	2.00	2.50	3.50
Steel Sheet Piling				
72,000 sq.ft. straight section Lgths. to 40 ft.	1.40	1.30	1.13	1.76
83,000 sq.ft. arch section Lgths. 40 to 60 ft.	1.50	1.37	1.16	2.00
3,000 sq.ft. arch section Lgths. 60 to 100 ft.	2.00	1.70	1.30	2.50
20,000 cu.yd. earth spoil bank	.30	.30	.29	1.00
5,000 cu.yd. loose rock excav.	.70	1.25	.53	1.60
15,000 cu.yd. solid rock excav.	1.00	1.25	.90	2.40
Gate house and valves (lump sum)	41,000.00	52,200.00	44,000.00	44,000.00
12,100 cu.yd. 2,500-lb. conc.	14.50	15.00	17.00	12.70
13,650 cu.yd. 1,500-lb. conc.	10.00	11.00	11.00	9.97
500 cu.yd. 1-14 conc.	9.00	8.00	8.00	7.00
7,800 lin.ft. wooden guard fence	.80	.75	.80	.70
920 lin.ft. pipe hand rail and link fabric	1.70	1.45	1.95	1.30
4,100 lin.ft. 8-in. vit. pipe slope drains	.55	.80	.54	.65
40 cu.yd. grouted paving inlets for slope drains	8.00	20.00	7.00	6.00
6,000 lin.ft. 6-in. tile drains under structures	.80	1.40	.44	.80
11,500 lin.ft. wooden foundation piling	.95	.65	.50	.85
Three "caterpillar" gates (lump sum)	53,500.00	47,500.00	50,000.00	45,600.00
32,200 bbl. portland cement	2.55	2.40	2.60	2.70
1,390,000 lb. reinforcing steel	.0425	.037	.05	.04
2,500 acres clearing	30.00	50.00	65.00	70.00
2,500 acres light clearing	23.00	10.00	42.50	20.00
Dewatering river channel (lump sum)	1,500.00	10,000.00	6,000.00	3,000.00
Using alt. "A" piling: grand total, without clearing	$2,198,727	$2,323,429	$2,404,868	$2,664,507
Working days	700	750	600	625
Using alt. "A" piling: grand total, with clearing	2,331,227	2,473,429	2,673,618	2,889,507

West End-Manchester Bridge Substructure—Pittsburgh, Pa.

Commissioners of Allegheny County, R. G. Woodside, controller, opened bids Jan. 28, substructure for west End-Manchester Bridge over Ohio River. Involves 21,350 cu.yd. excav., 33,075 cu.yd. conc., 180,000 lb. steel reinforcing dowels and removal of all or portions of 28 buildings (cost of this latter item included in totals only). Four bids were received, difference between lowest and highest, $236,354 or 24 per cent. Bidders are: (A) Foundation Co., Grant Bldg., (awarded contract); (B) Dravo Contracting Co., Dravo Bldg.; (C) Vang Construction Co., Grant Bldg.; (D) Booth & Flinn, Ltd., 1942 Forbes St. V. R. Covell, county engineer.

	A	B	C	D
14,850 cu.yd. excav. for foundation below El. 703.00	$3.75	$4.00	$7.00	$11.90
6,500 cu.yd. excav. for foundation above El. 703.00, including removal existing masonry	2.00	2.00	3.00	5.80
13,160 cu.yd. conc. in foundation of Piers Nos. 2 to 8, incl., except cylindrical caissons of Pier 6	$11.00	$8.00	$15.00	$13.60
300 cu.yd. conc. in cylindrical caissons of Pier 6	6.50	30.00	20.00	10.55
15,600 cu.yd. conc. above foundations in Piers 2 to 8 incl.	10.50	12.00	8.00	11.70
1,350 cu.yd. conc. in foundations of north abutment	9.50	13.00	12.00	15.95
1,430 cu.yd. conc. in reinforced conc. walls of north abutment above foundations	22.00	22.00	16.00	15.95
735 cu.yd. conc. in gravity conc. walls of north abutment above foundations	21.50	20.00	14.00	15.95
500 cu.yd. conc. in toe walls	11.00	10.00	12.00	14.45
180,000 lb. steel reinforcing and dowels	.045	.03	.045	.035
54,000 lb. structural steel and anchor bolts and wrought-iron mooring rings	.085	.12	.07	.056
3,000 bbl. extra portland cement	2.25	2.00	2.00	2.50
33,000 cu.yd. of conc. admixtures	.25	.20	.25	.27
2,000 lin.ft. premolded concrete piles	2.00	2.50	.50	2.18
50,000 lb. steel sheet piling left in place upon written order of Dir.	.03	.02	.02	.04
25 m.ft.b.m. wood sheet piling left in place upon written order of Dir.	40.00	20.00	30.00	50.00
18,300 cu.yd. embankment	1.25	1.20	1.00	1.26
43,500 sq.ft. rock faced granite veneer	3.50	4.00	3.30	3.71
16,000 sq.ft. four cut finish granite veneer	4.00	5.00	5.20	6.48
Totals	$734,889	$758,345	$788,232	$971,243